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THE ILLINOIS ECLIPSE EXPEDITION TO ROCK SPRINGS, WYOMING.

JACOB KUNZ AND JOEL STEBBINS.

The expedition from the University of Illinois to observe the solar eclipse of June 8, 1918, was made possible by a grant from the research funds of the Graduate School of the University, and we are indebted to Dean David Kinley for his liberal action in this matter. At the outset our program was limited to such observations as could be made with photo-electric cells, since we knew that no other observers along the eclipse track would have this apparatus. There has been in the past a wide divergence in the brightness of the corona as reported by different observers. No doubt the corona changes in total light intensity as it varies in form during the sun spot cycle, but no observer has yet been able to follow these changes over a number of years.

Since our work was not a duplication of that of others, we could choose any favorable site. We learned, however, that Mr. Parkhurst of the Yerkes party at Green River was to undertake visual photometric observations, and, after some correspondence with Messrs. Frost and Parkhurst, it appealed to us that if the Illinois party could locate in the general vicinity of Green River, but far enough away from the Yerkes station so that a local cloud would not spoil all of the photometry, there would be opportunity to compare our standard lamps with those of Parkhurst, and in the event of clear weather we should have both visual and photo-electric measures with about the same atmospheric conditions. We accordingly chose the site of Rock Springs which is 15 miles east of Green River, and it was anticipated that for our small party of only two there would be a great advantage in being near a town of this size, population about 5000, so that accomodations, labor, and supplies would be readily available. This expectation was justified in the sequel.

Because of the congestion on the railroads special precaution was taken that our apparatus should not be delayed in transit, and through the courtesy of the officials of the American Express Company our two

boxes of equipment were put promptly on a through car at Chicago, and arrived with no delay at Rock Springs. In addition to the express shipment of about 400 lbs., the remainder of the outfit was taken as baggage, but to make absolutely sure that nothing would go wrong, all of the delicate features including several galvanometers, photo-electric cells, standard lamps, etc., were carried in two suit cases. In fact, if everything but our hand luggage had been lost we would still have been able to secure some kind of results.

We arrived at Green River on May 29, and were very glad to have half a day to visit the Yerkes and Mt. Wilson stations, and to get the benefit of their experience, as the advance parties had been in Wyoming for nearly a month. The first reports as to the weather conditions were decidedly unfavorable, but of course it was an unusual season for that country. We learned that the strong winds would make any tent quite unsatisfactory, and we inspected with profit the various wooden shelters that had been erected at Green River, and planned to copy one of them for our own modest hut.

On returning to Rock Springs we spent the whole of May 30, Decoration Day, in reconnoitering in the vicinity. The centre of town was about eight miles from the central line, and the duration of totality was 94 seconds instead of 98 seconds at the maximum, but as our program of observations had been arranged to occupy 90 seconds, a second or two did not make much difference. However, we preferred to go south rather than north of Rock Springs, the difference being about one second for the first mile either way. In a Ford car we visited every neighborhood which was at all promising, and found half a dozen sites from which it was difficult to choose.

One bit of experience worth recording was our trip to Sweetwater, a mining village about five miles south of Rock Springs. This had been recommended to us as a good location, and according to the map had about fifty houses, being at the end of a railroad spur. Inquiries among local people indicated that Sweetwater might turn out to be suitable, though we expected that the train service would be limited. Not having a time table, we disregarded the railway and drove to Sweetwater in the Ford. On approaching the place we were surprised to find that the first house was not only empty, but that every pane of window glass had been smashed. The second house was in the same condition, and then the next, and it began to dawn on us that the village was deserted and that the mine had been abandoned. After passing through the place we found the family of the "caretaker" in the last house, but the bread winner was doing double duty by working in a mine some miles away. We had been looking for a building site, and here were scores of structures, any one of which could be had for

the asking. However, we had visions of the days and nights of preparation ahead, and for sentimental reasons, if for no others, we turned our backs on the haunted place and looked for more lifelike surroundings.

After half a dozen decisions and reconsiderations we finally found a place about 2 miles south of Rock Springs and 250 ft. higher than the town, which was easy of access but away from any much traveled thoroughfare. What was especially important was the probable freedom from smoke, particularly at the time of the eclipse. There was a coal mine at Blairtown about a mile to the northwest of us and another about the same distance northeast. Fortunately the eclipse came on Saturday when the mines closed down at 4 p. m., and the superintendents of the two places concerned, Messrs. Burnell and Vail, kindly undertook to guarantee that the fires would be banked and that there would be no danger of smoke for three quarters of an hour before totality, at 5:17. Before leaving Urbana where smoke has been a nuisance for a dozen years we vowed that with several hundred miles

FIG. 1. The Illinois Station near Rock Springs

of eclipse track to choose from we would make sure that this trouble at least would be left at home. The outcome was that only on a few occasions did smoke pass over our station, and then when we were not observing. Otherwise we were as secluded as though we had been far from any town.

The trouble from wind was not so easily disposed of, but we afterwards learned that we had located exactly where any experienced sheep herder would have placed his "shack", on the lee side of a ridge a hundred yards northwest of us, and where some of the breeze was deflected upward only to descend a short distance farther along.

We were fortunate in securing the services of a local contractor, Mr. Kellogg, who promptly put up the shelter. The size of the building was fixed partly by the standard lengths of lumber and partly by the dimensions of our apparatus, which in turn were governed by our

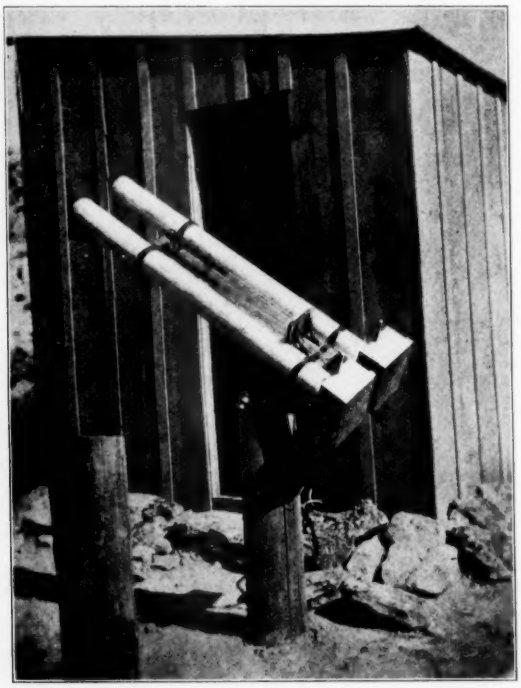


FIG. 2. Photometer tubes.

advance estimate of the probable intensity of the solar corona. We proposed to move a standard candle back and forth on a photometer bench until its light effect upon the cell would equal that of the corona, and we wanted to have all of the photometer inside the building when tests were made. We adopted 8x12 feet with ample ceiling height, and in this space was contained the entire outfit, except for the tubes which were mounted just outside the door in an enclosure for protection from wind.

The proposed observations were simple and required little of the usual perfection in astronomical instruments. The light sensitive photo-electric cell was contained in a metal box with a 1-inch circular opening, which in turn was at the end of a 4-inch tube, 48 inches long. At the upper end of the tube was a diaphragm 3¾ inches in diameter and smaller diaphragms were placed along the tube to cut out stray light. These dimensions gave 4° as the diameter of the circle of the sky which affected any point on the photo-electric cell. If the cell with the tube stationary was exposed to the corona at the time of totality, the diurnal motion in a minute and a half would not carry the corona out of the clear field, and therefore no clock work was necessary. Two similar tubes for duplicate measures were fastened on the equatorial mounting of an old three-inch refractor. Included with the apparatus was a small finder telescope, clamps in both motions, and slow motion in hour angle. The whole affair was bolted on a post, and was readily detached and put inside the hut for safe keeping. Either box containing a cell could be taken from the mounting and placed at the end of the photometer bench for exposures to the standard lamp.

What might be called the astronomical part of our equipment, just described, worked very well and served its purpose admirably. The necessary mechanical parts were made by Dr. Elmer Dershem, instructor in astronomy, and Mr. J. B. Hayes, mechanician in the physics department, at Urbana, and we are indebted to them for this and other valuable assistance in the preparations.

Each of the two photo-electric cells used on the corona was connected by wires running in a flexible metal conduit to its galvanometer and battery. We had about 300 volts available from three trays of flash light cells, which were sufficient for the microscopic currents used in this work. Our main standard light was an amylacetate candle, but we had several low voltage electric lamps which are more convenient to use. We secured a couple of 6-volt automobile storage batteries in Rock Springs, and these gave the current needed for the lamps and for lighting purposes about the hut. The galvanometers were mounted on a substantial concrete pier, the reading telescopes and the scale resting on supports which went to bed rock so as to be free from vibrations of the building.

All of our fears about difficulties in getting the apparatus in working order were unfounded. Being far from traffic, the galvanometers were perfectly steady, and the dry air of Wyoming eliminated troubles with electrical insulation. We were agreeably surprised, when the first circuit was ready to be tested, to find that conditions were unbelievably favorable. Exposures of a cell to light gave galvanometer deflections

which could be repeated with mechanical precision. Neither of us had ever seen anything like it before, and it remained for our cozy little hut in the desert to demonstrate what a model laboratory should

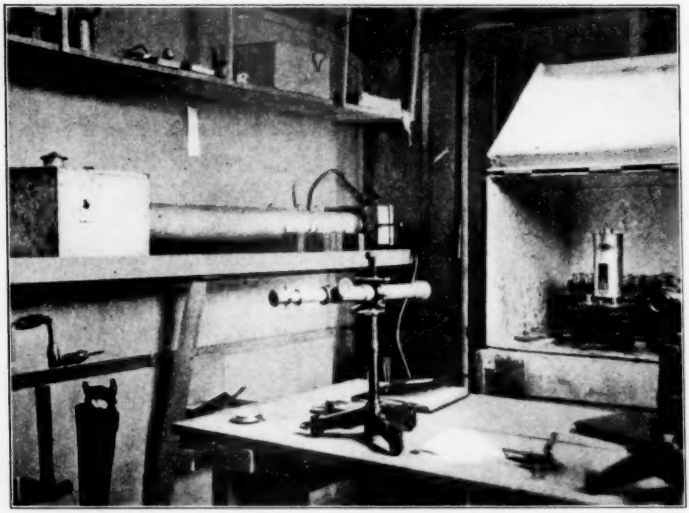


FIG. 3. Interior of hut, showing photometer bench, galvanometer, etc.

be. As a sample of the performance of a cell under these conditions we give the first test readings which were taken. Steady deflections produced by exposures to light were as follows:

	div.
	26.35
	26.45
	26.4
	26.3
	26.4
Mean	26.38

As the total range of the measures is about 1 part in 175, observations of equal accuracy on stars would give residuals of only a few thousandths of a magnitude. The intensity of the light, however, was 0.5 candle meter, or about 500,000 times brighter than the extra-focal image of a fifth magnitude star formed by the twelve inch objective at Urbana. The light measures of stars are carried on with an electrometer, which is enormously more sensitive than a galvanometer.

On more than one occasion on the trip we had a turn of good fortune, and perhaps the first thing that made us believe in our lucky star was that although we were not ready to make tests until the Monday before the eclipse, the sky promptly cleared for us and we got satisfactory readings on the waning crescent moon just before dawn on Tuesday and Wednesday mornings.

Those with experience in eclipse camps know that many plans go astray and unforseen troubles are likely to arise, and our case was no exception. We promptly had an accident and burned out our standard electric lamp; the best galvanometer went dead; and, to cap the climax, the watch which was our reliance for time stopped for ten minutes one day and started up again. However, such troubles were minor matters if we could only have a clear eclipse. The primary standard lamp was a candle, and there was no possibility of that failing us. We had two spare galvanometers and a dozen extra suspensions, so we could improvise something in that line. Finally, if we were to see the eclipse at all there would be no doubt when it came, and a watch was not an

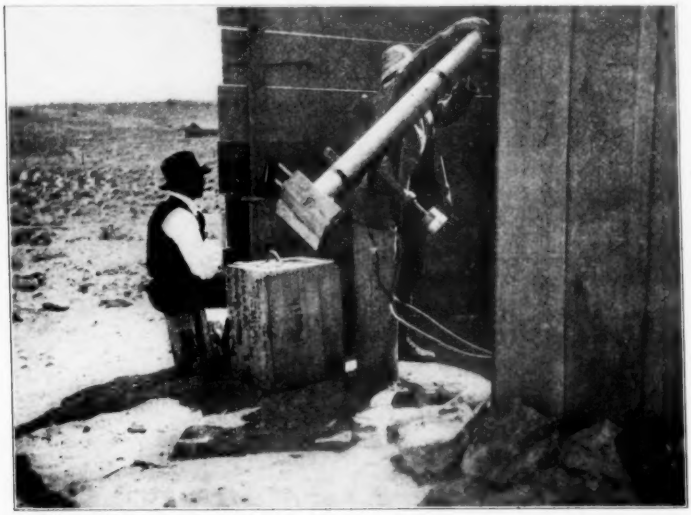


FIG. 4. Ready for the eclipse.

absolute necessity, but we quickly got another one from a local jeweler.

We had chosen Wyoming because every one familiar with the west warned us that in the Rocky Mountains there would be clouds in the afternoon, so when we got to Rock Springs it was something of a disappointment to encounter the very trouble we had tried to avoid.

Many of the mornings were clear, but increasing clouds came to a maximum not far from the hour of the eclipse. Of the ten afternoons preceding June 8, there were only two when we could have had complete success. On two others something might have been secured through haze, but on the remaining six days the conditions were hopeless. The only redeeming feature was that for the five days preceding Saturday it was bad every afternoon, which gave us hope that the weather might possibly change. On Friday we found opportunity to make a short visit to Green River and see the final preparations there, and we returned to our station in time for the afternoon clouds, and, this time, rain.

FIG. 5. Looking west thirty minutes before totality.

Eclipse day dawned beautifully clear, but we were only hopeful. Surely enough by nine in the morning a few small clouds were visible near the horizon, and they kept coming. By noon they were quite numerous, but overhead near the sun there was plenty of blue sky. All our preparations were completed, and there was not much to do but watch the clouds. Totality was at $5^h\ 17^m\ 01^s$ standard time. During the afternoon a few of our new friends in town came by to wish us good luck. For assistants we had been fortunate in securing Messrs. Homer Coté, and Paul Freeman, two mining surveyors who kindly gave us just the kind of help we needed. About two hours beforehand two

policeman furnished by the authorities of Rock Springs came, and we made plans for keeping back the crowd. This precaution was unnecessary for somebody had advertised Green River as the "official" place to view the eclipse, and various spectators actually made the trip from Rock Springs to Green River on that account. It turned out that not a soul came to bother at the critical time, and the six of us were left in the quiet with the feeling that we had it all to ourselves.

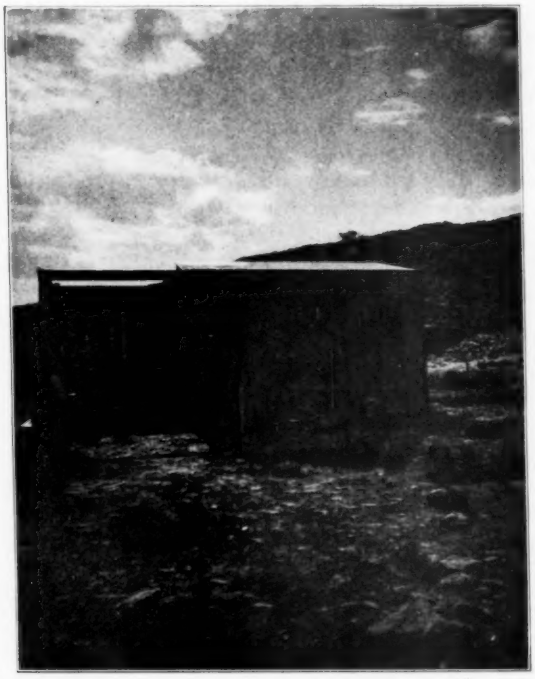


FIG. 6. Six minutes before totality. The sun was at the upper left hand corner of the picture, behind the cloud. At the critical time the clear space just below had moved up to the sun.

The sun was clear at first contact, but soon clouds were passing over and they kept getting worse. There was a bad place in the northwest which looked like a factory for clouds which were coming slowly from that direction and forming more and more. A half hour before totality there was little prospect, as the clear spaces were filling up, but about twenty minutes before time we became aware of a ray of hope in the shape of a clear space in the northwest, which, if it moved at the

proper rate, might possibly get to the sun at the right time. We did not want it to move too fast as there were other clouds beyond, so there was the race between the disappearing sun and this bit of clear sky.

At the call of "ten minutes" we took our stations, Messrs. Kunz and Stebbins inside to read the galvanometers, but with a plate glass window at the proper place for viewing the corona, Mr. Coté at the tubes, and Mr. Freeman as timer. At "six minutes", there being nothing else to do, one of us went outside and took a picture of the clouds (Fig. 6), then, in silence except for the monotonous tick of the metronome, we waited for our fate. What happened is shown in the written notes, the times being reckoned before totality.

33 minutes Sky 0.4 cloudy now. More coming from west. East half of sky pretty good.

18 minutes Clouded. Clear space 20° N. W. headed for it. 0.9 of window clouded.

14 minutes Space coming.

12 minutes (Exposures were made on clouds 8° N of sun for final test).

10 minutes At stations.

6½ minutes Took picture.

5 minutes Rainbow colors below.

4 minutes North of sun O. K.

3 minutes Nearly clear. Think we shall get it. Space (coming).

2 minutes FINE!

Contrary to our expectation the clouds were breaking up rather than forming at the critical period, and thus it came about that the immediate surroundings of the sun were absolutely clear during totality, There were clouds west, south, and east of the sun, 4 or 5 degrees away. but there was a wide stretch of clear sky to the north, and it was to this side that the measures of the sky background had been planned and were made. We were sorry to see that the clouds had almost certainly interfered at Green River, and people who had gone toward Sweetwater to be nearer the central line were also disappointed. In fact, as we have since learned, no other party on the entire eclipse track was favored with a perfect sky about the corona together with a clear space 8 degrees north of the sun, and if we had gone to any station other than Rock Springs we should have been unsuccessful.

It was fortunate that we had planned to take the observations in duplicate, the circuit of one photo-electric cell being made extremely sensitive, and the other only moderately so. A premature exposure threw the more sensitive circuit out of adjustment, but the safe side was not affected and perfect success was secured with that part. The

light of the corona turned out to be about seven times as intense as we had guessed, and on the side which was working we secured four complete measures of the corona and of the sky background.

The details of the work will be published in another place, but the preliminary results can be summarized here. The potassium photo-electric cell which was used has a maximum color sensibility in the blue, about wavelength 4700 A. As this is a sharp maximum it is not likely that the light of the prominences, which were extremely bright to the eye, had much effect upon the results. Different cells which we have made show the same color sensibility, so that while the measures are neither visual nor photographic, being nearer the latter, they can be repeated at future eclipses. The standard amylacetate candle was compared with the moon before the eclipse and also before leaving Urbana and after returning, especially on June 23, when we got it on a fine night and just before the moon touched the penumbra of the earth's shadow. This was as near an uneclipsed full moon as can be observed.

Remembering that the measures refer to blue light, the results may be expressed as follows:

Corona = 0.6 candle at 1 meter
= 0.6 full moon
= 0.1 circle of sky ½° diameter and 8° from uneclipsed sun
= 600 times circle of sky ½° diameter and 8° from eclipsed sun

A final reduction with corrections for atmospheric absorption may change these figures slightly but not much. By a coincidence the full moon is about equal in blue light to the standard candle at a meter distance, but this indicates that the candle is yellow compared with the white moon. To the eye the full moon gives 1/5 of a candle meter. The sky background during totality was much less intense than we anticipated.

Perhaps the most important result is that the corona is as much as one-tenth as bright as an area of sky equal in size to the apparent sun's disk. Of course, closer to the sun, especially with an ordinary atmosphere, the sky is more intense. Nevertheless, the problem of detecting the corona in full sunshine by means of a photo-electric cell does not appear absolutely hopeless, and we understand from Professor Hale that experiments in this direction have been carried on at Mount Wilson during the past summer.

The beauty and impressiveness of a total eclipse are seldom exaggerated by those fortunate enough to view it. One of us, Mr. Stebbins, had seen the eclipse of 1900 in Georgia, and that of 1905 in Labrador, the latter however being cloudy. Nevertheless, he was quite unprepared for the weird effect of the ashy light on the desert landscape shortly

before totality, and for the spectrum colors in the clouds about the sun as they were breaking at the last minute. The week of gloom on account of the weather, the dismal outlook as the clouds kept forming, the excitement of the approach of the clear sky, and the final happy outcome, made an experience never to be forgotten.

No account of an eclipse expedition would be complete without recognition of the assistance from local people, for it is the experience of astronomers everywhere that the inhabitants along any path of totality are ready to help the visiting observers in every possible way. We received uniform courtesy and aid from the people of Rock Springs, and in particular enjoyed the hospitality of the mayor, Dr. E. S. Lauzer, who did much to make our stay pleasant.

After the eclipse, there remained only the final calibration of the apparatus and the packing up, which was quickly done. We were not through with the excitement, however. On Sunday morning, we learned by telephone from Professor Frost that a first magnitude new star had been discovered on eclipse night by Barnard at Green River, and this news coming after the event of the previous day seemed unbelievable. The same evening, we had been driving with Dr. Lauzer, and on returning toward town we kept a lookout for Nova. It was just at dusk when we stopped in the open desert, a strange world in the fading light, and there in the east was the New Star; the sky was strange as well as the earth.

University of Illinois Observatory.
October, 1918.

IF I WERE SPOILER OF THE SKIES—

I'd stretch my fingers out to seize
The fringes of the Pleiades,
And weave them into tapestries
Of color and of grace.
A bunch of little stars I'd take
And fling them down into the lake
To watch the ripples tear and break
Their spangles into lace.

I'd rip the moon out from the skies,
Cut it in twain and cornerwise,
And rub the pieces in my eyes
To open up my sight
Till dreams of earth should shine as plain
As meadow flowers after rain,
And real things fade away again
Like mists into the night.

And last of my celestial fun
I'd reach my hand out for the sun
And pry its petals one by one
To where its gold heart lies;
I'd cup the flame and lift it high
Until it burst in melody—
And this I'd do if only I
Were spoiler of the skies.

ANCHUSA

THE ECLIPSE AT ARLINGTON.

J. M. KEMP.

Arlington, Oregon, was selected as the site for observing the eclipse of June 8, 1918, because of the likelihood of favorable weather conditions, and because I counted on obtaining a fine view of the approaching shadow from the south bank of the Columbia River. In the matter of weather, we were not as fortunate as could be desired, but our location was ideal for observing the shadow.

Leaving San Francisco on the evening on the fifth of June, I reached Arlington on the afternoon of the 7th. In Portland I procured a topographical map of the Arlington quadrangle, and a study of this convinced me that the best vantage point would be Turner's Butte, about 12 miles by road from Arlington. Its summit is about a thousand feet above the Columbia River, and about 250 feet above the surrounding bench lands. Not only did it afford a wonderful view to the northwest, from whence the shadow would come, but it also gave us a view for many miles to the southeast, so the receding shadow could be observed.

Our party was originally composed of my mother, Mrs. Jennie M. Kemp, of Portland, Oregon, and myself, both amateur astronomers. By good fortune we met with Dr. A. E. Douglass of the University of Arizona, and we decided to pool our efforts and erect a joint observing station. We are both greatly indebted to Dr. Douglass for his many helpful suggestions.

It was my desire to make special observations on the approaching shadow of the moon, and on Baily's Beads. Undoubtedly trained observers have made very full notes on these phenomena in times past, but I have not been able to find the information I desired, especially about the Beads. I wished to know whether they could be seen with the naked eye, and for how long they were visible just before and after totality. As for the shadow, my chief desire was to get the thrill that its rapid approach always gives to the observer.

Our party left Arlington by auto about 10:30 on the morning of the eighth, arriving at our station on the top of Turner's Butte about noon. The weather had been only slightly cloudy when we left the town four-fifths of the sky being clear. It got thicker steadily, and our spirits correspondingly lower. By the time totality came I had resigned myself to complete failure. We were most delightfully disappointed.

Being in an exposed position on the hilltop, we erected a windbreak with a large piece of canvas. Behind this Dr. Douglass mounted his telescope, and I spread my sheets on which I hoped to see the shadow bands.

In our work of preparation and observation we had the assistance of Mr. Hopper and Mr. Biggs, two business men of Arlington. Mr. Biggs watched carefully for the Beads both before and after totality. To Mr. Hopper was confided the task of counting off the seconds during totality. He was provided with a metronome beating seconds, and a split-second stop watch.

As nearly as could be ascertained from the maps available our station was very nearly on the center line of the eclipse. My measurements indicate that we were not more than 100 yards off the center, and I am sure we could not have been a quarter of a mile away. As we did not have our location determined with exactness we did not feel that our observations on the time of the contacts would be of any real value, and did not go to great pains on this point. I knew my watch to be within a minute of the correct time, and according to a trainman seen at the C. W. R. & N. station in Arlington on the morning of the eighth it was 8½ seconds slow. This man claimed to know the variation of his watch within a second. I had estimated the time of first contact at about 2:42 (not figuring seconds) and second contact at four o'clock to a second.

At the time of first contact the clouds were quite thick, at times completely obscuring the sun. At 2:42 all of the party looked for first contact, but this was not observed until 2:51, at which time the moon had taken a considerable bite out of the sun.

At 3:15 a fresh breeze sprang up from WNW, about two points north of the direction from which the shadow would come. Previous to this time there had been little wind, and what there was came from WSW. The clouds were several miles high, and seemed to be moving from SW to NE.

I shall be much interested in learning whether other stations observed any change in the wind about this time. It seems possible that it had some connection with the approach of the shadow, seeing that it came from so nearly the same direction. I regret exceedingly that none of our party observed the direction of the wind after totality, but we were all so busy comparing notes on the total phase that this matter was forgotten.

At 3:55 everyone was at his station. Mrs. Kemp had an Eastman Kodak equipped with a Goerz lens of about 6 inches focal length, and was prepared to take a snap of the crescent just before totality in hopes of photographing the Beads, and two pictures of the corona

during totality. I had a camera strapped to Dr. Douglass's telescope mounting. Mr. Biggs was watching for the Beads through a smoked glass, and Mr. Hopper had his metronome running, and was ready to count at the call of time. I alternated between watching for the shadow and looking for signs of the Beads. None were seen by either Mr. Biggs or myself. Dr. Douglass saw them through the telescope about two seconds before totality. Mrs. Kemp snapped her camera just two seconds before second contact, and Dr. Douglass said afterward that he saw the Beads just as I called "Beads" as a signal for her to take the picture. I had delayed calling for the picture till the last moment, hoping to see the Beads with the naked eye. Dr. Douglass said the Beads were observed over an arc of 20 to 30 degrees. He had a 3-inch telescope magnifying 26 diameters. It is his opinion that with perfect seeing the Beads could not be seen with the naked eye, but might possibly be seen with a good fieldglass.

About 3^h 57^m 30^s the shadow was first seen on the clouds in the WNW, covering a considerable area. There was a rift in the clouds about 15 degrees from the horizon, and all the clouds below this were in the shadow when it was first observed. Had we had perfect weather we could have seen the shadow strike Mount St. Helens, 90 miles away, and then bound to Mt. Adams, fifteen miles nearer, then second by second leaping over the western foothills of the Cascade Mountains. Owing to the hazy atmosphere Mt. St. Helens could not be seen at all, while Adams could be picked up only with effort. The great spectacle was in the clouds this day. The advancing shadow reminded one of a procession of splendid majesty, that for all its speed was the very embodiment of strength and dignity, almost of Divinity. It was as if we stood in the path of some gigantic juggernaut, the opposing wheels of which were 30 miles to the right and to the left, crunching out all life between. From its crushing blow there could be no escape. Useless it was to attempt to fend the blow, or flutter from the approaching doom. The onrushing shadow approached with a velocity comparable only to the speed of thought, and with all the inexorableness of death. The mighty moment was upon us.

About 30 seconds before second contact the shadow could be seen distinctly on the ground about 15 miles away, on the Oregon side of the Columbia river. Owing to the haze, or to our close attention to the spectacle of the clouds we had not seen it distinctly on the Washington side of the river, although we could plainly see that the foothills of the Cascades were in the shadow. But a definite line on that side was not observed. Owing to the haze the shadow as seen on the Oregon side was not as sharp as I had expected, there being a zone of probably two miles that was not clearly in or out of the shadow.

Shadow bands were looked for all during the five minutes preceding totality, as well as just after totality, but none were observed. The light began to fail very rapidly a few minutes before totality, and we did not realize that the clouds were suddenly getting much thinner. In fact, I had resigned myself to not seeing the corona and was much surprised to see it when totality came.

Second contact was pretty sharply defined, much more so than I had expected from reading on the subject, and from judging by the indefinite zone in the approaching shadow. I do not feel that I was over a quarter of a second in error in calling second contact, nor over half a second in calling the third. The time of second contact was not noted exactly, but it was some time after four o'clock sharp and before ten seconds after four, at which latter time I looked at my watch. I opened the shutter of my camera on the telescope mounting at about the fifth second of totality, and closed it at the 105th.

I allowed myself till the twentieth second to open the camera, and study the corona through the field glasses. These are eight power Perplex prism glasses, showing a very good field. No prominences were seen, and no details could be made out in the corona. Probably only the inner corona could be seen through the haze. It extended about a fourth of the diameter of the sun in the equatorial regions, going up to about latitude 60 degrees. No polar streamers were seen, the corona in these regions being very narrow, although distinct.

From the twentieth to the fiftieth second I observed the corona with the naked eye. So absorbing was this view that I forgot to look for the stars and planets. About twelve people had come out from Arlington and gathered on the hilltop, and I do not think that anyone saw a star. One observer in Arlington reported seeing one. This was probably due to the haze, which prevented the stars being prominent.

In color the corona was white, with no colorings or markings. From the fiftieth till the one hundredth second I sketched the corona, later throwing the sketch away, because there was so little of detail that I did not consider it worth preserving. At the one hundredth second I left my drawing board and closed the camera, and looked for the coming light. There it was, only a few miles away, plainly seen both on ground and in the sky. At third contact I took two or three seconds to look for Baily's Beads, but as none could be seen I turned my attention to the receding shadow. Up in the sky it could be seen as a great black ball, rolling along the clouds into the southeast, The spectacle both on land and sky was magnificent. For about five seconds the shadow was nearly circular, as seen on the clouds, quickly flattening into an ellipse, and later into a broad band traveling into the bright sunlight in the far distance. The view of the receding shadow was

even finer than of the light as it came upon us, owing largely, I think, to the peculiar effect of the sunlight on the clouds to the southeast.

The duration of totality as estimated for our station was one minute 56½ seconds. The time caught by Mr. Hopper with the stop watch on my calls of second and third contacts was 1 minute 56⅔ seconds, which we felt was pretty satisfactory considering the four chances of error in recording the time.

Mrs. Kemp's picture of the sun before totality was taken with a stop of 32, time 1/50 of a second. A red glass was used as a shade. The first picture during totality was given four seconds exposure, and the second ten seconds. Both were with a stop of 2.9. No success was had in securing a photograph of Baily's Beads, and the camera was moved during the 10 second exposure, making that a failure. But a very good picture was secured with the second exposure. It showed a corona about half the sun's diameter in the equatorial regions.

Before totality Mount Hood had been seen only dimly. Just after totality someone called out "There's the corona" and someone else called out "There's Mount Hood". It was a beautiful sight. Standing just outside the shadow it received very little light, but it had for a background the hazy atmosphere of Clackamas County, which while only a few miles farther from the shadow received several times the light that fell on Hood. Moreover, the sun being in the west, the side of Hood toward us received very little light indeed, and in consequence the great cone of the mountain stood out in dark silhouette. With the coming light it faded from sight, except for very close observation. It was about 75 miles from us in a direct line.

REPORT OF OBSERVATIONS OF TOTAL ECLIPSE OF SUN, JUNE 8, 1918, MADE AT LIMON, COLORADO.

MORGAN SANDERS.

Station.

Having observed the total solar eclipse of May 28, 1900, at Rocky Mount, N. C., (using small refractor) and having been much impressed, among other phenomena, by the approach of the shadow, I selected Denver as station in hope of seeing shadow come over snowclad tops of Rockies. But knowing from investigations of Dean Howe of the University of Denver, Director of Chamberlin Observatory, of weather conditions in Colorado, and of Professor Todd of Amherst who made a study of weather conditions along the whole line of the shadow path,

that chances of clear sky were better in eastern Colorado I determined if cloudy in Denver on the morning of the eclipse to leave for Matheson, Colorado, about 70 miles southeast of Denver. As cumulus clouds were forming early on the morning of the eighth over the Rockies, I left Denver at 12.01 p. m. for Limon, Colorado, to make connection for Matheson. Connecting train being four hours late I could not get through to Matheson, except possibly by private conveyance, and as sky to southwest (the direction of Matheson) was less encouraging, I decided to remain at Limon, although about fifteen miles north of central line of shadow path.

Equipment.

Because of the distance I carried no instruments, but used an opera-glass with power of about 2½ times, giving very wide field. Eyes protected for partial phases by sun glasses taken from celestial oculars and arranged in front of eye lenses of opera-glass.

Sky.

On arrival at Limon at 2:30 p. m., sky, a deep blue, was filled with cumulus clouds sailing lazily along from the N. W., but a much more discouraging feature was a mass of cirrus thickening to an alto-stratus steadily creeping up from the S. W. horizon until it had covered the sun before time of first contact. This cloud, however, was quite thin in vicinity of sun. First contact was seen through it with ease. In this cirrus cloud was a long, rather narrow, wedge of clear sky and by a miracle of good fortune the sun occupied this space during totality. Though spoken of as clear sky the space within the wedge was really covered with the thinnest veil of cirrus, so fine and so delicate as scarcely to be visible.

Contacts.

Contacts were observed but times only roughly noted.

Approach of Totality.

Approach of totality was marked by the usual uncanny darkening of the landscape (greenish yellow hues), and by the restlessness of animal and bird life. Shadow bands were seen on a light cement pavement.

Shadow.

Approach of shadow was not very well seen because of topography of neighborhood but an interesting feature was the successive blotting out of cumulus clouds to the N. W. as it came on. The recession of shadow was very finely seen as it rushed over the rolling prairie, constantly curving to the south, because of Limon's position north of the central line of the shadow path.

TOTALITY.

At totality the corona was well seen. Though round in contour it was characterized by three streamers in the general direction of the ecliptic, one to the east and two to the west. Three huge prominences were placed triangularly about the moon's disc. They were of a deep red and most brilliant. One planet and two stars were seen; Jupiter, very easily, to the east, i. e., above a little to the left of the sun, Aldebaran, and another star which because of lack of time was not identified —perhaps Capella. These objects were seen through the cirrus cloud and were placed triangularly about the eclipsed sun.

COMPARISON WITH ECLIPSE OF MAY 28, 1900.

The outstanding difference was the shape and character of the corona. That of 1900 much elongated along the ecliptic; this much rounder —polar rays and equatorial streamers more nearly equal in length. 1900 corona quiescent; 1918 characterized apparently by great repulsive forces. Indeed this difference was most marked.

Prominences in 1900 two, grouped close together; 1918 three, much larger and grouped almost as a perfect equilateral triangle on sun's limb. 1900 eclipse somewhat darker than 1918 perhaps due to location of station, fifteen miles from center of shadow.

1419 W. Lanvale St.,
Baltimore, Md.

TWENTY-SECOND MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY.

[*Continued from page 637.*]

NOTE ON THE MAGNITUDES OF THE VARIABLES IN MESSIER 15.

BY S. I. BAILEY.

The magnitudes of the variable stars in Messier 15, as in other globular clusters, are in general very uniform. The mean magnitude of 59 variables is 15.71. The extreme difference between the mean magnitudes of the brightest and faintest variables is 0.51 magnitude. The average deviation from the mean is ± 0.08 magnitude. Within this small range, however, the magnitude appears to be related to the distance from the center of the cluster. When grouped according to distance, the variables are shown to increase in brightness from near

the center to the border by about 0.3 magnitude. This change is rapid near the center but nearly or quite ceases at a distance of 4′ or 5′.

The observed change in magnitude does not appear to be due to instrumental or photographic effects, nor to color. It may be true, therefore, that in Messier 15 the fainter variables are generally near the center. This is probably not true, however, of all globular clusters.

NOVA AQUILAE No. 3, 1918.

By E. E. Barnard.

The Nova was first seen at about $10^h\ 50^m$ (90th meridian time) at Green River, Wyoming, on the night of June 8 when I was returning to the town after packing the eclipse plates. Professor Frost was at once notified of the discovery. The star attained its maximum brightness on June 9, after which it faded rather rapidly. It has since been followed continuously when the weather would permit observations of it. The Nova was so bright on June 9 that some uncertainty exists in the comparison of its brightness. Observations of various stars whose difference of brightness is about the same as the stars and the Nova on that night were begun at Green River and continued at the Yerkes Observatory to see what correction was necessary to the observations. These are being continued. The light curve shows decided fluctuations. The Nova is shown on my photographs on 54 dates from 1892 June 29 to 1917 March 20. These photographs show, as do those obtained at the Harvard College Observatory, that previous to its outburst the light of the star was unsteady. It seems to have been fainter in 1917.

THE PROMINENCES OF THE TOTAL SOLAR ECLIPSE OF 1918, JUNE 8.

By E. E. Barnard.

Two lantern slides were shown, both from the same negative which was taken with the 6-inch (61½ feet focus) horizontal coelostat of the Yerkes Observatory, at Green River, Wyoming, through clouds, with an exposure of 20 seconds. On the original the moon's image is 7 inches in diameter. The first slide shows the prominences around the entire circumference of the sun. The second slide shows two of the prominences on a larger scale. They are both on the western limb of the sun, one north and the other south of the equator. The upper or south prominence, which looks like some queer insect or like the skeleton of some strange animal, was about 47,000 miles high. The lower left hand or north prominence on the original is made up of

vertical filaments of a flame-like structure. They both show a trend of material towards the equator. South of the skeleton prominence there are two very low lying prominences from which coronal matter seems to directly emanate. The exposures with this instrument were made by Miss Mary Calvert.

SOME REMARKABLE SMALL BLACK SPOTS IN THE MILKY WAY.

By E. E. Barnard.

Lantern slides were shown of individual dark spots and markings which gave evidence of being real non-luminous objects seen in black or dark projection against parts of the Milky Way. These specimens were selected from the remarkable region north of *θ Ophiuchi* and from the region of the bright star cloud in *Scutum*. A catalogue is being formed of these objects. From this catalogue the following were represented on the slides.

Slide 1. The extraordinary region north of *θ Ophiuchi*, the center of the slide being in:

$$1875.0 \quad \alpha\ 17^h\ 13^m \quad \delta\ -21^\circ\ 0'$$

Slide 2 showed two of these objects that closely resemble each other in form. They are sharply defined curled dark markings in the positions:

(a)	1875.0	α	17^h	$37^m.7$	δ	-20°	11′
(b)	1875.0		17	16 .5		−21	50

Slide 3. Two other very definite dark markings in this region:

(a)	1875.0	α	17^h	5^m	*	δ	-21°	40′	Long, curved, sharply defined at west edge
(b)	"		17	15	55		−23	29 .5	S-shaped figure.

Slide 4 shows four small dark markings:

(a)	1875.0	α	18^h	59^m	29^s	δ	−7°	4′.8
(b)	"		17	9	57		−18	20 .6
(c)	"		18	55			− 5	40
(d)	"		18	25	31		−26	9

(a) Small, black, curved; like a black fan-shaped comet.

(b) A similar object to (a). Both of these objects have a sharply defined "head" and diffused curved "tail".

(c) A group of small well defined black spots.

(d) Small, 3′ in diameter, round—like a black planetary nebula, which it may be.

SYSTEMATIC CORRECTIONS TO AND WEIGHTS OF STELLAR PARALLAX.

By Benjamin Boss.

An attempt has been made to systematize the several series of parallax determinations. Corrections were formed, both constant and those dependent on right ascension. The concluded formulae represent the observed values as well as could be expected, and demonstrate that there are well defined seasonal changes in some of the results. It is also evident that in the mean the probable errors of the parallaxes as given by the authors are the true probable errors. The systematic corrections will be revised before publication in order to include the results of unpublished parallaxes which have been generously offered since the reading of this paper.

REAL STELLAR MOTIONS.

By Benjamin Boss.

The real motions were represented for all parallax stars with observed radial velocities. Several peculiarities are manifest, in addition to the features shown in *Astronomical Journal*, No. 736. There appears to be a tendency of motion on the part of some stars toward the region 0^h to 3^h of right ascension and $0°$ to $+ 20°$ of declination. The apices of stars whose space velocity is over 75 kilometers per second lie almost wholly along the galaxy, and they are definitely confined within the region $140°$ to $340°$ galactic longitude. They are composed of both dwarf and giant stars. There are no apices for stars of high velocity between longitudes $340°$ and $140°$. The apices of stars whose space velocity is under 15 kilometers per second avoid the region $140°$ to $340°$ galactic longitude. They form the better part of the group between 0^h and 3^h of right ascension, and $0°$ and $20°$ of declination. There is likewise an indication of a secondary plane of distribution. There is the indication of a cluster of the apices of A type stars in the region $285°$ to $295°$ of right ascension and $0°$ to $10°$ of declination. Their several velocities vary little from the mean value of 30 kilometers. Then there is a progression in the mean velocity of stars arranged according to type starting at about 40 kilometers for M and K type giants, decreasing to about 15 kilometers for stars of type B and increasing rapidly for dwarf stars, apparently reaching a maximum about the G type.

STELLAR LUMINOSITIES AND ABSOLUTE MAGNITUDES.

By Benjamin Boss.

The absolute magnitudes of parallax stars of known type were plotted according to type showing the familiar division into giant and dwarf classes. There are a considerable number of stars whose absolute magnitudes correspond to neither classification. This may be due to errors of parallax and type, or to physical causes. The absolute magnitudes of the giant stars appear to vary according to type, the G type stars being somewhat brighter in the mean than the B or M types. It would also appear that the dwarf stars decrease linearly in magnitude until they reach the M type, when there is an abrupt decrease.

THE LIGHT-CURVE OF NOVA AQUILAE, No. 3

By Leon Campbell.

Up to the present time (August 20) nearly 1200 observations of this Nova have come to hand, mainly from experienced variable star observers, and, in general, in response to *Harvard Bulletin* No. 661, which contained a map of the region to the magnitude 6.0. It is interesting to note that of the 134 observers, 70 of these were independent discoverers, and 25 of these were Americans, not only professional and amateur, but laymen as well. The average deviation of all the observations from a smooth curve drawn through the plotted points, is about ± 0.12. If we reject those made on the 9th of June, when the star was at its maximum, this deviation would be diminished to about ± 0.10.

The star was at normal brightness, magnitude 10.5, on June 3, and on the 7th it was at magnitude 6.0 and rapidly rising. M. Moye, of Montpellier, France, appears to have been the first to have seen the Nova, closely followed by Luizet and Luyten. It was then nearly of the 1st magnitude, and when seen in America, it had risen to the magnitude 0.5. By the 9th it had increased to at least the magnitude -1.0, and was probably a half magnitude brighter. It seems that the arrival at maximum and its abrupt change in spectrum were coincident. From here the curve closely resembles that of Nova Persei No. 2, discovered in 1901, although the variations are not so marked or rapid. Observations have been received for every night since discovery.

Harvard Circular No. 208 contains a map of the fainter comparison stars and will enable one to observe the Nova telescopically, when it becomes too faint for naked eye work.

It looks as though this Nova would be as thoroughly observed as any previous Nova, and that the observations would be even more accurate and accordant. It is desirable that the light variations be carefully watched to ascertain whether they are coincident with the spectral changes.

THE SPECTRUM OF NOVA AQUILAE, No. 3.

By Annie J. Cannon.

The paper dealt with the principal changes in the spectrum between June 9 and August 17, 1918. The striking resemblance to the spectrum of α *Cygni* was shown by photographs of the two spectra taken with the same instrument and objective prism. When next photographed, on June 11, the transition to the Nova type was complete. The light bands were of great intensity and the dark lines were double. On July 14, dark lines of reversal were situated on the bright bands. From June 16 to 25, many of the dark lines became faint or invisible, but line 4059 remained strong. On June 26, a change had occurred, so that the bright bands were distinctly double and line 4059, instead of being a strong dark line, had become bright. Photographs were exhibited which show this change between June 25 and 26, and a copy of the light curve of the Nova, showing the connection between the variations in the spectrum and the oscillations in the light of the star, which occurred at intervals of about ten days, the range being one half of a magnitude. In general, during this oscillatory period, line 4059 was dark at the maximum phase, and bright at minimum. An exception occurred during the maximum of July 26 to 29, when the line remained bright. Changes in line 4059 have taken place in several other novae. In the discussion of Nova Persei No. 2, *Harvard Annals* **56**, 54, it is stated, "The variation in intensity and position of this band, since its appearance on February 24, is one of the curious phenomena of this spectrum."

Progressive changes have occurred in several lines. The bright band 4650 became distinctly visible on June 16, and was nearly equal to $H\gamma$ on July 14. The compound band, $H\gamma$ and 4363, was the strongest band on August 17, and 5007 had then become nearly equal to $H\beta$.

Photographs taken with the 24-inch reflector on plates stained with pinacyanol, show that the line $H\alpha$ exceeded all others in brightness from June 11 to August 17, 1918.

THE SPECTROSCOPIC BINARY, BOSS 1275.

By J. B. Cannon.

Boss 1275, $\alpha = 5^h\ 16^m.0$, $\delta = +\ 29°\ 29'$, is a spectroscopic binary discovered at Mt. Wilson. Both spectra are visible. The spectral type is A and magnitude 5.7. Lines are rather poor. Those measured are chiefly $\lambda\lambda$ 4549, 4481, $H\gamma$, and K, and occasionally a few faint ones which are sometimes sufficiently clear to permit of measurement.

The following elements were determined from 40 plates:

$P =$	27.43 days	$\omega_1 =$	29°.80
$\gamma = -$	14.17 km	$\omega_2 =$	209 .80
$K_1 =$	116.91 km	$T =$	2,421,142.00 J. D.
$K_2 =$	116.12 km	$a_1 \sin i_1 =$	42,730,000 km
$e =$	0.247	$a_2 \sin i_2 =$	42,440,000 km

A SHORT METHOD OF MEAN PLACE REDUCTION WITH NATURAL NUMBERS.

By Wm. A. Conrad.

With the advent of multiplying machines many operations formerly carried on exclusively with logarithms are now being made more speedily and easily with natural numbers. Among the irksome tasks required of the astronomer probably mean place reduction is one of the least inspiring. Heretofore this has been a stronghold of logarithms and only the logs of the values of the factors are published by the Almanacs. It is to make it possible to dodge this computation that apparent places of some of the more frequently observed stars are published in the Ephemerides. To suggest how this operation of mean place reduction may be more easily and quickly performed and consequently less boresome is the object of this paper.

The computations have been adapted to the use of the Millionaire multiplying machine, which shows striking advantages over the use of logarithms.

To test the time saving that could be effected by machine computation, the writer inveigled four of his friends into performing a certain task both by logarithms and by the machine. He himself was a fifth. being in a strict sense the only one familiar with machine operation although all knew or were capable of understanding its manipulation after a few words of explanation. All were computers of more or less experience and speed. The original purpose of this test was to ascertain the relative speed of the two methods but incidently another very significant feature was brought to light; namely, the relative number of mistakes committed. The results are tabulated below.

Computer	Time Ratio, Machine to Logs	Errors Machine	Logs
A	.735	0	1
B	.710	0	2
C	.830	0	3
D	.650	0	3
E	.488	0	1

The salient points brought to light are: (a) every computer was able to do the task more quickly on the machine, (b) no computer made a single mistake on the machine while every one made one or more mistakes by logarithms, (c) a little experience in machine manipulation enables the computer to still further shorten the time necessary to complete a task. This last point is brought out when one considers that computer E was the only one who had had any extended experience with the machine. It should not be inferred from the above table, however, that no mistakes are ever made with the machine, but only that fewer mistakes occur. Experience demonstrates that while the machine may be infallible yet the human mechanism is not, and from this source mistakes will slip in.

THE REDUCTION OF SCHÖNFELD'S OBSERVATIONS TO THE HARVARD PHOTOMETRIC STANDARD OF MAGNITUDES.

By J. J. Crane.

At Mannheim and Bonn, from the year 1860 to the year 1875, Schönfeld observed 118 variable stars, making some twenty to twenty-five thousand observations. These observations were made and recorded with the greatest care, and the positions of the comparison stars given. An interesting account of the apparent loss of these observations and their discovery by Professor Edward C. Pickering is given in *Harvard Annals* **33**, 75. The unreduced observations were published later by Valentiner. (Heidelberg Observatory Vol. 1.) Professor Pickering gives the photometric magnitude of almost all the comparison stars used by Schönfeld which he carefully determined, and from this number of the *Harvard Annals* **48**, No. 3 the purpose of his work is quoted as follows:

> "In order to render these observations available for determining the periods and light-curves of the variables, they must all be reduced to uniform scale of stellar magnitudes. This involves first, the determination of the magnitudes of the comparison stars, and second, the reduction of the observations to this scale."

The present work is the second reduction. Of the 118 stars observed by Schönfeld, 25 have a variation of less than three magnitudes in light, the 93 selected for reduction equal or exceed this variation.

Work on the following stars has been completed, approximately 3700 reductions having been made:

001838	R Andromedae	190159	R Aquilae
015912	S Arietis	200715a	S Aquilae
021024	R Arietis	204405	T Aquarii
050953	R Aurigae	225120	S Aquarii
070310	R Canis Minoris	233815	R Aquarii
143227	R Boötis	235350	R Cassiopeiae

These observations have all been plotted at the Harvard College Observatory and smooth curves drawn through the points. The resulting light-curves show the care and accordance of the original observations. Most of the stars were frequently observed; few unavoidable gaps occur. The light-curves are smooth, and in remarkably good accord with the typical curve of the star, the average deviation being well within one-tenth of a magnitude.

The results must necessarily contain the personal peculiarities of the observer. There seems to be a slight difference in the value of the light steps between those made with the Steinheil comet seeker and those with the 6-inch refractor. Valentiner also mentions having observed a more marked difference in the light steps between the two instruments when the red stars, such as *o Ceti* and *R Leonis*, were under observation, those of the comet seeker being smaller than of the refractor. He attributes it to the different color of the objectives and the red color of both stars. The limit of seeing with the refractor used by Schönfeld was in the neighborhood of the thirteenth magnitude stars. The naked eye, opera glass, a comet seeker, and a 6-inch refractor were used in making the observations.

The variation of the period of the variables, while under observation, also any change in the nature of the typical light curve, will be revealed by the reduction of these observations to the Harvard photometric scale, and they will be brought into accord with the work of present day observers.

SIMULTANEOUS VARIATIONS IN SOLAR RADIATION AND SPECTROSCOPIC DETERMINATIONS OF THE SOLAR ROTATION.

By Ralph E. De Lury.

In offering the explanation that the variations in spectroscopic measurements of the rate of the sun's rotation were produced by changes in haziness between the point of observation and the sun, the writer made the suggestion that the solar radiation should exhibit simultaneous variations. It has been established that the profound variations in solar radiation as measured at the earth's surface are due to the haziness caused by volcanic eruptions. Minor variations are no doubt

caused by the terrestrial haziness produced by meteors and induced by the ionizations accompanying the variable auroral discharges. Forest fires and dust-bearing air-currents also produce haziness. When the effects of all such terrestrial sources are estimated or eliminated it will be possible to investigate more thoroughly the possibilities of effects produced by interplanetary or solar dust. In the meantime it is of value to compare the published measurements of rotation and radiation during the period in which the former have been made, namely, 1887 to the present time. In the following table the intensities of the solar radiation, "expressed as percentages of the general mean for each station", are taken from the charts given by H. H. Kimball (*Bulletin Mt. Weather Observatory*, Vol 5, Pt. 5, p. 301) and extensions thereto computed (in a similar way) by the writer from Kimball's tables of solar radiation intensities (measured at Washington) published from time to time (*Monthly Weather Review*, 1913-1918). The values of the equatorial velocity of the sun's rotation are expressed in km/sec. Both sets of measurements are of course affected by the local conditions at the points of observation, nevertheless it is apparent that general terrestrial haziness lessens the values of both.

Date	Radiation	Rotation	Observer			Observatory
1887-8-9	1.02	2.09	Dunér			Upsala
1899-0-1	1.02	2.05	"			"
1901.7	1.05	2.06	Halm			Edinburgh
1902.5	1.00±	1.97	"			"
1903.4	.90±	2.02	"			"
1904.5	.99±	2.06	"			"
1905.5	1.01	2.04	"			"
1906.5	1.01	2.01	"			"
1906.8	1.01	2.07	Adams and Lasby			Mt. Wilson
1908.3	1.01	2.06	" " "			" "
1914-5	.97±	1.95	St. John, Adams, Ware			" "
1909.8	1.02	2.04 DeL.				Ottawa
1910.5	1.00	1.97 "				"
1910.9	.98	1.93 "				"
1911.7	1.00—	1.98 "	2.01 JSP.			"
1912.4	1.00+	2.01 "	2.01 "			"
1912.8	.83	1.96 "	2.00 "			"
1913.4	.93±	1.96 "	1.99 "	1.98 HHP.		"
1913.7	.95	1.99 "	(1.97) "			"
1915.1	1.00—	2.00 "				"
1915.5	.95	1.94 "		1.95 "		"
1916.3	.96	1.97 "				"
1916.8	.93	1.93 "				"
1917.2	.90	1.89 "				"
1917.6	.96	1 93 "				"
1917.8	.98	1.98 "				"
1910.9	.98	2.08	Storey and Wilson			Edinburgh
1911.4	.99	1.86	Hubrecht			Cambridge
1911-2	1.00, .83	2.00	Schlesinger			Allegheny
1911-2	.95±	1.95±.1	Evershed and Royds			Kodaikanal
1913.2	.90±	1.95±	" " "			"

Dunér's high values of the rotation were derived at times of high radiation. Halm's values show a decided drop in 1902 and 1903, ascribed by him to changes in the sun but probably caused by the haze produced by the eruptions of the volcanoes in the West Indies (May to October 1902) which caused the great decrease in radiation. The Mount Wilson measures show ageement also with the radiation values. For the period 1909 to 1917 the writer's measurements of rotation fluctuate with the fluctuations in Kimball's measures of radiation at Washington. It is reasonable to suppose that the low values obtained in India by Evershed and Royds in 1912 and 1913 may have been due to the haze caused by the eruption of Katmai in June 1912. Storey and Wilson obtained an exceptionally high value, Hubrecht a very low value and Schlesinger a medium value, local conditions being a factor. The Upsala and Edinburgh values are high also for the reason that they were made in the red part of the spectrum.

SPECTROSCOPIC MEASUREMENTS OF THE SUN'S ROTATION AT ITS EQUATORIAL LIMBS AND AT POINTS MIDWAY BETWEEN THEM AND THE CENTER OF ITS DISC.

By Ralph E. De Lury.

By employing a pair of double-tongued prisms over the slit of the solar spectrograph it was possible to make simultaneous photographs of the spectra from the center of the solar disc, the equatorial limbs and points midway between them. The measurements of 75 plates taken during various degrees of haziness yielded the following values of the rate of the solar equatorial rotation from the midway points and the limbs:

Number of Plates	λ	Rotation Limb km/sec.	Rotation Midway km/sec.	Difference
56	5600	1.885	1.994	0.109
14	5200	1.913	2.006	0.093
5	3950	1.996	2.061	0.065

It may be reasonably supposed that the limb values are smaller than the midway values because an overlapping spectrum of haze affects the weaker limb spectrum to a greater degree and because the lines in the limb spectrum are weaker than those in the stronger spectrum of the midway points. It is desirable that the law of change in passing out to the limb of the sun be investigated, and it may be that the values of the solar rotation, unaffected by blended spectrum of haze, may be inferred therefrom.

THE NATURE OF A SUPPOSED CYCLIC VARIATION IN THE SOLAR ROTATION.

By Ralph E. De Lury.

In discussing briefly the nature of the "cyclic variation" of 0.15 km/sec. in the equatorial rate of the sun's rotation announced by H. H. Plaskett from some measures made in Ottawa in the midsummer of 1915, the writer gave some evidence to show that this variation was due to changes in terrestrial haze, stating also, that "in general high values of the rotation in the observations mentioned were obtained on the brighter days and low values on the hazier days". Plaskett has criticised this explanation, without applying the criterion suggested by the writer. The following summaries of Plaskett's measurements, and measurements of his plates and the writer's, support the explanation in a satisfactory manner.

Plaskett makes the following references to haze:

		Velocity, km/sec.
June 24,	"B, 3-4, a little haze near sun,"	1.846
July 4,	"B, 3-4, haze,"	1.893
July 20,	"B, 4, no haze",	2.026
July 23,	"B, 4-5, positively no haze",	2.003
Aug. 16,	"B, 4, practically little or no haze,"	1.977

Thus low values of the rotation are associated with low brightness and haziness, while higher values are associated with higher brightness and lower haziness. The following summary of Plaskett's 111 plates shows the same thing:

		km/sec.
19 plates, B, "5" and "4-5", i. e., above "normal",	Mean	1.975
50 plates, B, "4", i. e., "normal",	"	1.958
42 plates, B, "3-4" and "3", i. e., below "normal",	"	1.942

In the writer's previous note on this subject measurements of weak and strong lines on his own plates for the two days June 24 (hazy) and July 20 (bright)—when Plaskett obtained his lowest and highest values,—showed differences of 0.082 and 0.014 km/sec. between weak and strong lines. These have been remeasured (six times in all) and yield differences of 0.143 and 0.022, pointing to an even greater effect of haze than at first supposed. The writer's measures of Plaskett's plates show the same effect, thus:

June 24,	weak lines, 1.760,	strong lines, 1.855,	diff. 0.095 km sec.
July 20,	" " 1.994	" " 2.022	" 0.028 "

The writer must consequently restate his conviction that the variation in question was due to changes in terrestrial haze.

A POSSIBLE RELATIONSHIP BETWEEN NUMBERS OF METEORS AND QUANTITIES OF NITROGEN COMPOUNDS IN FRESHLY FALLEN RAIN AND SNOW

By Ralph E. De Lury.

During the past ten years analyses have been made at the Dominion Experimental Farm, Ottawa, of the amounts of "free ammonia", albuminoid ammonia", and "nitrates and nitrites" in rain and snow. The yearly results have been given in the *Experimental Farm Reports* by Dr. Shutt; a summary is also given in the *Transactions of the Royal Society of Canada*, **11**, 3, p. 63, by Shutt and Dorrance. Omitting the exceptionally large values obtained during the forest fires of September, October and November 1908, the results as pointed out, show a maximum in August and a smaller maximum in April. The present writer suggests that this may be due to meteors which show in general a maximum in these two months. Charts of the following data seem to indicate that this is a probable explanation:

Month	Free Ammonia	Albuminoid Ammonia	Nitrates +Nitrites	Total	Numbers of Meteors (Chambers)	Meteor Showers (Chambers)	No. of Meteors (Denning)
Jan.	0.225	0.102	0.140	0.467	2804	10	8
Feb.	.207	.122	.218	.547	1826	10	10
Mar.	.181	.227	.288	.696	1764	12	15
Apr.	.532	.268	.360	1.160	5585	17	28
May	.493	.091	.253	.867	2120	4	28
June	.411	.086	.269	.766	2353	2	28
July	.442	.093	.341	.876	10670	14	33
Aug.	.650	.193	.525	1.368	31516	56	85
Sept.	.299	.069	.194	.562	4304	13	42
Oc.	.585	.072	.261	.918	6840	29	29
Nov.	.414	.096	.225	.735	8319	38	36
Dec.	0.349	0.116	0.174	0.639	4055	17	22

The numbers of meteors and important meteor showers are taken from Chamber's "*Handbook of Astronomy*", while the last column has been computed from W. F. Denning's catalogues of meteor orbits *Monthly Notices of the Royal Astronomical Society* covering the years 1907-16 during which (and in 1917) the analyses of rain and snow were made. Meteoric dust may induce the action of nitrogen with hydrogen or oxygen (with the aid of water vapour and solar energy), or the dust may bring down ammonia and nitrogen oxides from the regions of low pressure and temperature where it is possible for them to form in sunlight, or through the agency of the auroral discharges.

THE STEWARD OBSERVATORY OF THE UNIVERSITY OF ARIZONA.

By A. E. Douglass.

The late Mrs. Lavonia Steward of Tucson made a gift of $60,000 to the University of Arizona for the purpose of erecting an astronomical observatory. The war has prevented completion of the instrument and building. The location is at Tucson on the campus of the University of Arizona. The valley of Tucson is large with a slight slope towards the river water and partly surrounded by low mountains. A test of atmospheric conditions showed the higher portion of the campus to be very favorable. A reflecting type of instrument was decided upon after testing the sixty-inch reflector on Mount Wilson. The director has been largely freed from class-room work in order to devote time for research. In choosing work appropriate for the new observatory, local climatic factors indicate the advantage of work on the sun and on other objects where daily continuity of observation is desirable.

ATMOSPHERIC HAZE CAUSING TWILIGHT EFFECTS.

By A. E. Douglass.

Observers of solar radiation have noted an excessive haze absorption in 1916. This seems associated with fine colored twilight effects observed at a maximum in September to November, 1916. A brief calculation indicated a layer of haze about twelve miles high in the atmosphere. This haze was actually observed and was found to have a rapid velocity towards a southwesterly direction.

THE COLOR INDEX OF NOVA AQUILAE No. 3.

By Alice H. Farnsworth.

Slides were shown of the spectral intensity curves of the Seed Process, Seed 30, Cramer Isochromatic Instantaneous, and Wratten M photographic plates. Magnitudes derived from such a series of plates used with suitable filters give measures of the relative intensity of certain integrated portions of the spectrum. Series of photographs of Nova Aquilae No. 3 on different kinds of plates show shift of maximum intensity from time to time.

USEFULNESS OF A "MOVIE" CAMERA FOR PHOTOGRAPHING PHENOMENA OF SOLAR ECLIPSES.

By Edwin B. Frost.

The photographic records of the flash spectrum at a solar eclipse have hitherto been composites of the rapidly changing appearances of the lines during about two seconds, at second and third contacts. In view of the present commercial perfection of the motion picture cameras, it seemed to the writer worth while to attempt to secure, with their aid, a record of the phenomena at short intervals during those two seconds.

The spectrum was formed by three large prisms of Mantois glass, placed in the beam from the coelostat. Behind the prisms came the camera lens, made by Brashear for another purpose, with aperture 50 mm and focal length 400 mm. The image of the spectrum fell on the film of the motion picture camera, from which the usual short focus lens had been removed. The crank was turned by Mr. Blakslee at the rate of two turns per second giving 16 exposures per second, each of about 1/30 second duration.

Heretofore there has always been danger that the exposure for the flash would be made too soon or too late, even if the signals are given by an experienced person observing visually with another instrument for that purpose. But with the motion picture film, it is entirely feasible and desirable to begin exposures in ample time before totality; and to continue them until a few seconds after totality has begun, and conversely at third contact. Thus there can be no danger of missing the flash at either contact, and a record is given of the reversing of the lines of higher level, which occurs many seconds before the real flash.

In this case (June 8, 1918, at Green River, Wyoming) I had the exposures begin 60 seconds before second contact, and continue until about 5 seconds after totality had begun; the film was then kept at rest for about 80 seconds to secure the spectrum of the corona; then started again 5 seconds before third contact and run for an additional minute. About two hundred feet of film were thus exposed, and a thousand or more impressions of the spectrum were obtained. Unfortunately the clouds that were passing cut off all fine details of the flash, leaving no impression for many exposures at the beginning of totality; and the record indicates the coming and going of the clouds; for the last 30 seconds the sky was nearly clear and the spectra are over-exposed. Bright gamma of hydrogen is seen on many exposures. It would seem to be safe to make the exposures even more rapidly at

another eclipse favored with a perfectly clear sky: I estimate that 1/50 second would suffice for an exposure time with this apparatus. The later exposures, through a better sky, show excellent definition.

An attachment was arranged to give a small black dot at one corner of the film at every beat of the chronometer, which operated a small electric flash lamp. Thus the time could be inferred accurately for all exposures.

It would be easy to turn the camera by motor at a precise rate and to connect it with a chronograph, if desired.

THE SPECTRUM OF NOVA AQUILAE ON JUNE 8, 9, AND 10, 1918.

By Edwin B. Frost and J. A. Parkhurst.

Slides were shown from negatives of the spectrum of *Nova Aquilae* as obtained at the Yerkes eclipse station in Wyoming with two prismatic cameras operated by Mr. Parkhurst. Faint emission fringes appear on the side toward red of a few of the dark lines on June 8. They are much less distinct on June 9 and this change is believed to be real.

The first exposure on June 10 showed that the change to a typical spectrum of a nova had arrived during the daytime at Green River. The last photograph of the spectrum on the night of June 9 was at $21^h\ 40^m$ G. M. T., and the first on June 10, at $15^h\ 56^m$ G. M. T. Taken in connection with reports from Europe, this shows that the change in the spectrum must have occurred within a very few hours.

Preliminary measurements show, in addition to the hydrogen series from Beta to Xi, some lines of much shorter wave-length, the last ones at slightly less than λ 3500. Some of these may be due to helium.

Definitive publication in the *Astrophysical Journal.*

[*To be Continued.*]

THE INFLUENCE OF ASTRONOMY ON HUMAN THOUGHT.*

REV. HECTOR MACPHERSON.

Astronomers are sometimes called "star-gazers"; and the word, though often playfully applied, has in it a certain suggestion of pity, if not of contempt. It is usually applied by those who know just enough of astronomy to know that there is in its cultivation an unworldly and idealistic motive, and too little of the science to realize its great practical and intellectual benefits,—indeed, its necessity to the human race.

Those of us who have studied and followed the science realize that it is by means of astronomy that latitudes and longitudes are determined, and extensive navigation made possible,—that it is by means of astronomy that land-surveys can be carried out and accurate time determined. These are the most obvious practical uses of the oldest of the sciences.

"The student of astronomy," the late Professor Young once remarked, "must expect his chief profit to be intellectual—in the widening of the range of thought and conception." There is a danger, in emphasizing the practical necessity of astronomy to the world, of forgetting the part played by astronomical science in the development and progress of human thought—on the world on which we live and the universe of which it forms a part. It is to the influence of astronomy on human thought that I desire to direct your attention this evening.

It is a wide subject, and in dealing with so wide a subject, it is necessary to be as concise and definite as possible. So I shall deal with the subject in two parts, which may be roughly classified as (1) cosmological, and (2) cosmogonic. An American scientist in a popular work used the phrases, "the extension of the Universe in space," and "the extension of the Universe in time." I shall take these phrases to designate the two parts of my lecture.

The Extension of the Universe in Space.

(1) *The early period.* From the earliest times, the human mind has been confronted by the great problems presented by the natural world. The name of the first actual students of nature must remain for-

* Read before the British Astronomical Association (West of Scotland Branch) in Glasgow, March 22, 1917.

ever in obscurity. It is tolerably clear, nevertheless, that astronomy is the oldest branch of science, because the heavenly bodies are the most prominent of natural objects. The early observers of nature must have noticed the phases of the moon and the changing aspect of the starry skies, and later, the fact that the sun varies in its altitude above the horizon.

In all probability, this kind of knowledge grew up simultaneously among various peoples. There are traditions of early astronomers and astrologers in China, in India, and in Egypt and in Babylon, for early astronomy was inextricably mixed up with astrology and religious ceremonial, and thus the priests of the ancient religions were in many cases the pioneers of astronomical observation.

An intelligent study of nature is almost invariably accompanied by what is called a cosmology or world-concept. The mind of man, even in primitive conditions, is not content with knowing things as they seem to be; it desires to know things as they are, and to penetrate behind the veil of appearances. The human mind ever seeks a world-concept. Thus, even in very primitive times, men formulated theories of the natural order and of the relation of the earth, our dwelling place, to the outside world as a whole.

Every ancient people had its cosmology or concept of the order of the world, and accompanying this, its cosmogony, or theory of the world's origin. That these early ideas were crude and fantastic is not to be wondered at. The late Professor Pfleiderer pointed out that among early peoples "cosmogony is at the same time theogony," and we might also say that cosmology is at the same time theology. To the early peoples, nature was full of deities, gods of land and of sea, of sun and stars, of storm and tempest. Both religion and science were born of a crude cosmo-theology,—largely the product of wonder and fear.

The early races, Chinese, Hindus, Egyptians, and Babylonians, seem to have made considerable progress in astronomical observation, but they never got beyond this confusion of theology and science. Many of the empirical facts of astronomy were noted and recorded by them. The five planets were known to these races, and the paths of sun and moon laid down. In short, a large number of interesting facts were ascertained, but there the achievement ended. There were world-concepts in plenty, but these world-concepts were not the result of observation. They were guesses at the riddle of the universe, a jumble of pagan theology and astrological superstition. The Hebrews and the Greeks were, in the things of the spirit, the greatest races of antiquity and to them fell the task of separating religion from science. The Hebrews, who had little or no interest in natural science, disentangled

religion from crude naturalism and pseudo-science, while the Greeks were the founders of actual scientific observation, and based their theories on actual fact.

Of course, it is impossible to draw hard and fast lines between various races. The transition from the pseudo-science of the Babylonians to the careful observation of the later Greeks was a gradual one. Thus Homer and Hesiod give us some idea of the similarity of the early Greek ideas of the world to those of the Babylonians and other ancient peoples. And the Ionian school of philosophers, important and sagacious as were their theories and guesses, still followed a deductive method. They framed theories with little or no observations of natural phenomena. And so even in the period of the greatest triumphs of Ancient Greece, we cannot truthfully talk of the influence of astronomy on human thought. The influence was slight, for thought was *a priori* and theories were deductive.

With Eudoxus of Cnidus, the cosmology of the Greeks entered on a new phase. With all his limitations, Eudoxus may be described as the first investigator of cosmological problems from a purely scientific standpoint. The earlier philosophers had proceeded on the ground of reason alone. Their method* was deductive. Eudoxus, on the other hand was an inductive thinker. First and foremost he was an observer of the phenomena of the heavens, and, to explain these phenomena, he advanced his famous theory of homocentric spheres. Whether the theory was ever more to him than a convenient working hypothesis is uncertain. Dr. Dreyer, who has made a close study of the Eudoxian theory, believed that Eudoxus only regarded his spheres as "geometrical constructions suitable for computing the apparent paths of the planets." Be this as it may, the theory, complicated and cumbersome as it was, accounted fairly well for the observed celestial motions. If there is a possibility that the theory was merely a theory to Eudoxus and his pupil Calippus, who improved and extended it, it was a great deal more to Aristotle. In fact, it formed the basis of that great philosopher's world-concept, and in estimating the influence of astronomy on human thought, it must not be forgotten that the astronomy of the day formed the scientific basis of the theory of man and the universe which held sway for so many decades and centuries over the human intellect. To Aristotle, the spheres were actually in existence, portions of the vast mechanism of the universe. He found it necessary to add twenty-two extra spheres. Calippus had assumed the existence of thirty-three, so that, as left by Aristotle, the system comprised fifty-five separate spheres. Aristotle as we all know, adopted the belief in the spherical

* A Parmenides it is true, had guessed the great truth of the spherical form of the earth and this was accepted by Eudoxus.

form of the earth, and gave to it the weight of his great authority.

It is somewhat remarkable that while more and more stress came to be laid in philosophical and speculative circles on Aristotle's opinion as to the immobility of the earth, the astronomical theory on which he based his hypothesis,—the spheres of Eudoxus,—was soon discarded. The progress of practical astronomy, by demonstrating its inadequacy, hastened its rejection. The necessity of regulating time, the need for an accurate calendar, had stimulated observation of the sun and moon, and this in turn influenced other branches of astronomy. At Alexandria, under the patronage of the dynasty of the Ptolemies, a school of astronomy was founded, and systematic observation of the heavenly bodies was made. As Dr. Dreyer has well remarked, "Vague doctrine's and generalizations were abandoned, while mathematical reasoning founded on observation took their place. That this change occurred about the middle of the third century (B. C.) was a circumstance not unconnected with the simultaneous rise of the school of Stoic philosophy. Both in abstract philosophy and in science, the wish to get on more solid ground now became universal, and no science benefitted more by this realistic tendency than astronomy."

To Apollonius of Perge is due the distinction of inventing the famous theory of epicycles, which superseded the hypothesis of Eudoxus. The idea of concentric spheres was abandoned. Sun, moon, and stars were assumed to be in motion round the earth in circular orbits. But some explanation had to be given of the irregularities of the celestial motions. In essence, the systems of Apollonius, Hipparchus, and Ptolemy were identical, but the latter worked the epicycle theory to its fullest perfection. Thus the astronomy of the day gave credence to the belief that the earth was the center of the universe, and man the crown of creation.

Ptolemy was the last great name in ancient astronomy. In his great work, the "Syntaxis," which came to be known by its Arabic name of the "Almagest," were summed up the results of the ancient Greek astronomy. There was an air of finality about his great book. He was himself the last great astronomer, for the great days of science seemed to be at an end. The Hellenic culture had largely exhausted itself; an air of hopelessness and futility had settled over the world, and the Stoics rather concerned themselves with problems of conduct than with questions concerning the natural world; while the early Christians, expecting the early return of Christ, did not busy themselves with the affairs of this world. Accordingly, slowly but surely, science and philosophy alike seemed to die out. When the Emperor Justinian suppressed the Neoplatonist Schools in 529, he merely gave legal expressions to an accomplished fact. The long night of the so-called "dark ages" had begun.

As the Church grew more and more powerful, as it became gradually not so much the Christian Church as the Church of Rome, the Ptolemaic world-view was stamped with the approval of ecclesiastical authority. And so, for hundreds of years, this remarkable system held sway over the minds of men, and was used to support and demonstrate the Roman Catholic view of life.

(2) *The Copernican Revolution.* With the coming of the Renaissance, the minds of men were once more turned to intellectual things. A number of men of scientific tastes arose,—such as Nicholas of Cusa, Purbach and Muller, better known as Regiomontanus. These men, however, remained faithful to the orthodox Ptolemaic theory. And when the famous system of Copernicus was first propounded, it came on the world as a bolt from the blue. It is difficult for us of today to realize the magnitude of the scientific revolution which Copernicus initiated. From time immemorial, all,—except, perhaps, a few irresponsible thinkers among the Greeks, such as Hicetas and Aristarchus, whose names were unknown save to the learned few,—had believed the earth to be the center of the universe, the end and aim of creation. Only the earth was inhabited, and for the earth's inhabitants the other bodies in the universe had been created,—the sun to give light and heat to the earth, and the moon and stars to be convenient secondary light-givers in the absence of the sun. This conception had been taken up by the Roman Church, and by the Scholastic philosophy. Little wonder, then, that the appearance of the great work of Copernicus in 1573 caused no small stir. At first, it was treated by the authorities with contempt, and then with furious vindictiveness. Copernicus himself was beyond the reach of popes and priests, for he survived only until the day of the publication of his great work. It soon became apparent, however, that he was but a voice crying in the wilderness. When Copernicus died, the Reformation struggle was at its fiercest. Yet Protestants vied with Roman Catholics in denouncing a theory which they felt to be subversive to the true faith. Luther referred to Copernicus as "an upstart astrologer, who strove to show that the earth revolves." "This book", he continues, "wishes to reverse the entire science of astronomy, but sacred scripture tells us that Joshua commanded the Sun to stand still, and not the Earth." Melancthon went so far as to suggest the forcible repression of such views. The struggle became fiercer and fiercer. The advocacy of the new view was one of the charges on which Bruno was condemned to death and burned at the stake in Rome in 1600. The second "martyr" of the Jesuits was harassed and persecuted solely for his adhesion to the Copernican system. Indeed, it was in the course of the contest between Galileo and the Papal authorities that Copernicanism was finally condemned. We

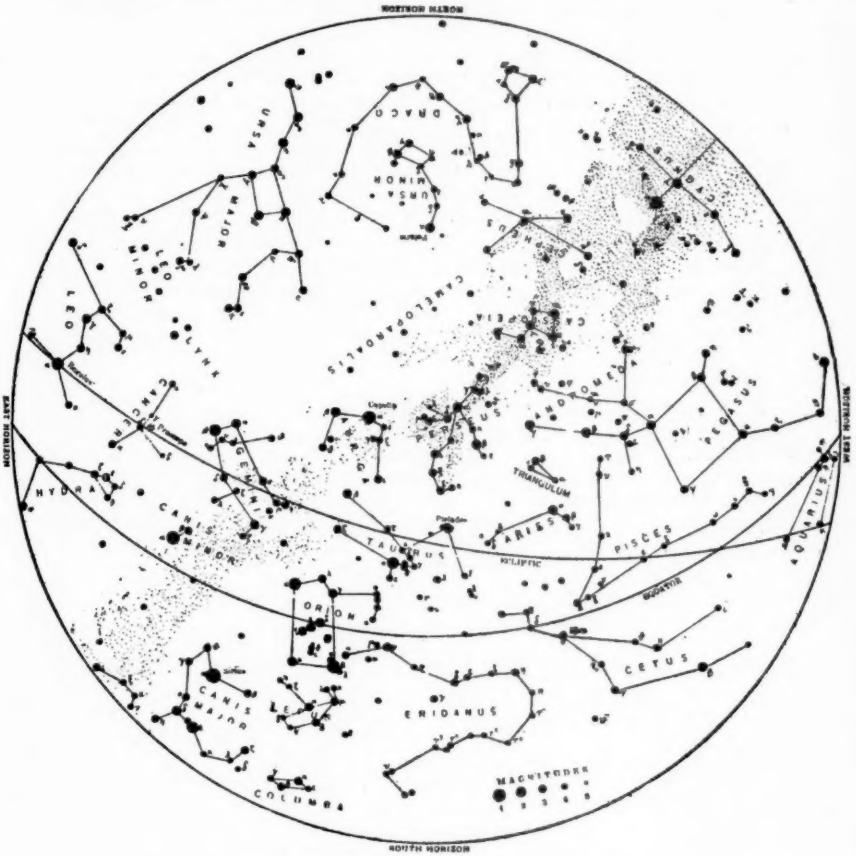
are all familiar with the story of the struggle, how Galileo discovered the spots on the sun, the satellites of Jupiter, and the phases of Venus, thus weakening the Ptolemaic system and confirming the Copernican. Each of these new discoveries was doubted, disbelieved, and minimized. But with all their furious bigotry, some of these Roman theologians saw clearly the essential influence of the Copernican system on human thought. After all, the vital point of the new doctrine was not an increased number of celestial bodies or the existence of mountains in the moon and spots in the sun. It was the fact that the earth was no longer the centre of the universe. Grant the truth of the Copernican system, and the whole outlook on the universe is changed. As the earth is no longer the only world, so man's supremacy becomes less certain. Boundless possibilities are opened up. The greatness of Copernicus is not to be measured by what he did, but by what he made possible. A vast extension of the universe was revealed; and so the philosophic and theological outlook was vitally affected by the new system. While the Scholastics were still vainly trying to refute Copernicanism, and the theologians were engaged hurling anathemas at the heads of its supporters, the new system of the world was being established on a firm theoretical basis.

(3) *The Newtonian System.* Tycho Brahe was no great constructive thinker; he contributed little to the actual cosmological conception of the time,—for while he abandoned the Ptolemaic theory, he could not adopt the Copernican, and found refuge in a half-way house known to posterity as the Tychonic system, which, while conceding the motion of the other planets round the sun, preserved the immobility of our world. But Tycho was one of the most industrious collectors of data whom this world has ever seen, and from the data collected by him the new system of the world was to be finally confirmed. After his exile from Denmark, he became acquainted with Kepler, who came into possession of Tycho's huge mass of observations when the latter died. By means of these,—the most perfect hitherto made,—Kepler sought to discover, (1) how the planets revolved round the sun, and (2) why they revolve. He was successful in his first quest, and the three empirical "laws" of planetary motion are the monument of his labours. He failed in his second quest. The force controlling the planetary motions he believed to have its origin in the sun. But he was unable to reach any definite conclusion, and it was reserved for Newton to enunciate the law of gravitation, which made intelligible the empirical laws of Kepler. The importance of Newton's great work cannot be overrated. Laplace declared that the "Principia has a pre-eminence over all productions of the human intellect...."

(*To be Continued.*)

PLANET NOTES FOR JANUARY, 1919.

The sun having been at its lowest declination on December 22 will move slowly north during January and the days will lengthen perceptibly during the month. The earth will be at perihelion, i. e., nearest the sun on January 3.



THE CONSTELLATIONS AT 9:00 P. M. JANUARY 1.

The moon phases will be as follows.

New Moon	Jan.	2	at 2	A.M.	C.S.T.
First Quarter		9	" 5	A.M.	"
Full Moon		16	" 3	A.M.	"
Last Quarter		23	" 10	P.M.	"
New Moon		31	" 5	P.M.	"

The moon will be at perigee January 11 and at apogee January 23.

Mercury will be at greatest elongation, west from the sun 23° 13′, on January 7, so that it will be easily seen as a morning planet during the week January 5-12. Southern observers will have the best opportunity to see the planet at this time. Mercury will be at aphelion on January 29.

Venus will be evening star, setting in the southwest about an hour after the sun. The brightness of this planet is comparatively low now because of distance from the earth, still its stellar magnitude is placed at −3.4, over four times as bright as Sirius. Venus and Uranus will be in conjunction, less than a degree apart on the evening of January 30. Uranus will then be 52′ north of Venus.

Mars crosses the meridian about 2 p. m. and so is too near the sun for valuable observations. He will be at perihelion January 8. Mars and Uranus will be in conjunction on January 22 at 1^h G. M. T., the latter being 22′ north of the former at that time.

Jupiter will be at opposition on January 17 and so may be observed all night. This brightest of the evening planets is in the constellation Gemini, moving slowly westward. Jupiter will be in conjunction with the moon, 2° 24′ north of the latter on January 14 at 10^h 50^m p. m. C. S. T.

Saturn is in the constellation Leo rising at about 8 p. m. on January 1. The rings of this wonderful planet are tilted now so that the shorter axis of the apparent ellipse of the outer ring is about one fifth of the longer axis, so that the details of the ring system can be well seen when the atmospheric conditions are good. Saturn will be in conjunction with the moon, 6° 50′ north of the latter, on January 18 at 4^h 47^m p. m. C. S. T.

Uranus is too near the sun to be easily observed during this month. It will be in conjunction with Mars on January 22 and with Venus on January 30.

Neptune will be at opposition on January 28 and so is in best position for observation. This planet is in the constellation Cancer about a degree east and half a degree south of the fourth magnitude star δ. Its motion will carry the planet almost directly toward the star during this month. The planet can be seen only with the aid of a telescope and looks almost exactly like a star of the eighth magnitude.

Saturn's Satellites.

[From the *American Ephemeris.*]

CENTRAL STANDARD TIME.

I. Mimas. Period 0^d $22^h.6$.

1919	h		h		h		h	
Jan. 1	12.5	W	Jan. 10	11.3	E	Jan. 19	10.2	W	Jan. 27	10.4	E
2	11.1	W	11	9.9	E	20	8.8	W	28	9.0	E
3	9.7	W	12	8.6	E	20	20.1	E	28	20.3	W
4	8.3	W	12	19.9	W	21	7.4	W	29	7.6	E
4	19.6	E	13	18.5	W	21	18.7	E	29	18.9	W
5	18.3	E	14	17.1	W	22	17.3	E	30	12.2	E
6	16.9	E	15	15.7	W	23	15.9	E	30	17.5	W
7	15.5	E	16	14.3	W	24	14.5	E	31	16.1	W
8	14.1	E	17	12.9	W	25	13.1	E			
9	12.7	E	18	11.5	W	26	11.8	E			

II. Enceladus. Period 1^d $8^h.9$.

Jan. 1	3.7	E	Jan. 9	8.9	E	Jan. 17	14.2	E	Jan. 25	19.5	E
2	12.6	E	10	17.8	E	18	23.1	E	27	4.3	E
3	21.4	E	12	2.7	E	20	8.0	E	28	13.2	E
5	6.3	E	13	11.6	E	21	16.8	E	29	22.1	E
6	15.2	E	14	20.4	E	22	1.7	E	31	7.0	E
8	0.1	E	16	5.3	E	24	10.6	E			

III. Tethys. Period $1^d\ 21^h.3$.

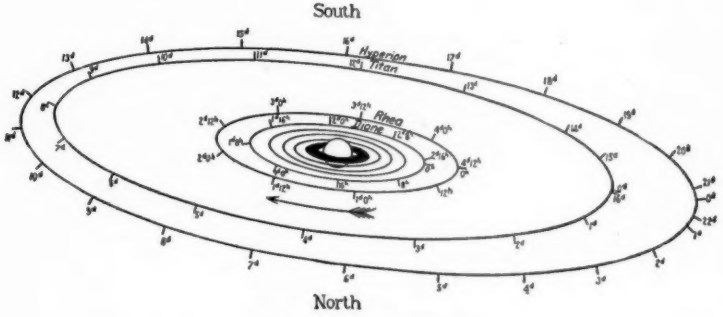
		h			h			h			h
Jan.	1	15.7 E	Ja.n	9	4.9 E	Jan.	16	18.1 E	Jan.	24	7.3 E
	3	13.0 E		11	2.2 E		18	15.4 E		26	4.6 E
	5	10.3 E		12	23.5 E		20	12.7 E		28	1.8 E
	7	7.6 E		14	20.8 E		22	10.0 E		29	23.1 E

IV. Dione. Period $2^d\ 17^h.7$.

Jan.	1	23.7 E	Jan.	10	4.7 E	Jan.	18	9.7 E	Jan.	26	14.6 E
	4	17.4 E		12	22.4 E		21	3.9 E		29	8.3 E
	7	11.0 E		15	16.0 E		23	21.0 E			

V. Rhea. Period $4^d\ 12^h.5$.

Jan.	1	10.3 E	Jan.	10	10.9 E	Jan.	19	11.6 E	Jan.	28	12.3 E
	5	22.6 E		14	23.3 E		24	0.0 E			



SATELLITES OF SATURN, 1918.

Apparent Orbits of the Seven Inner Satellites of Saturn at Date of Opposition, January 31, 1918, as seen in an inverting telescope.

VI. Titan. Period $15^d\ 23^h.3$.

Jan.	3	12.8 W	Jan.	11	17.2 E	Jan.	19	10.6 W	Jan.	27	14.9 E

VII. Hyperion. Period $21^d\ 7^h.6$.

			Jan.	11	2.0 W	Jan.	21	13.8 E			

VIII. Iapetus. Period $79^d\ 22^h.1$.

Dec.	31	17.7 E	Jan.	20	2.4 I	Feb.	7	17.9 W			

IX. Phoebe. Period $523^d\ 15^h.6$.

		α Ph.—α Sat.	δ Ph.—δ Sat.			α Ph.—α Sat.	δ Ph.—δ Sat.
		m s	′ ″			m s	′ ″
Jan.	1	−1 11.8	+9 12	Jan.	17	−1 30.3	+10 37
	3	14.1	9 24		19	32.5	10 46
	5	16.6	9 35		21	34.7	10 55
	7	18.9	9 46		23	36.8	11 03
	9	21.3	9 57		25	38.8	11 11
	11	23.6	10 07		27	40.8	11 19
	13	25.9	10 17		29	42.8	11 27
	15	−1 28.1	+10 27		31	−1 44.8	+11 33

Satellites of Jupiter, 1919.

[From the *American Ephemeris.*]

GREENWICH MEAN TIME.

JANUARY

Phases of the Eclipses of the Satellites for an Inverting Telescope.

I.

III.

II.

IV.

Configurations at 16h 15m for an Inverting Telescope.

Day	West	East
1	○ 2 · 1 ·	3 · 4 ·
2	2 · 1 · ○ 3 ·	4 ·
3	3 · ○ 1 2	4 ·
4	3 · ○	2 · 4 · 1 ●
5	3 · 2 · 1 · 4 ○	
6	4 · 2 · ○ 1 ·	3 ●
7	4 · 1 · ○ 2 · 3 ·	
8	4 · ○ 2 · 1 · 3.	
9	4 · 2 · 1 · ○ 3 ·	
10	4 · 3 · ○ 1 ·	2 ●
11	4 · 3 · ○ 1 2 ·	
12 ○ 1 ·	3 4 2 · ○	
13	2 · 4 3 ○ 1 ·	
14	1 · ○ 4 2 · 3	
15	○ 2 · 1 3 4	
16	2 · 1 · ○ 3 ·	4 ·
17	3 · ○ 2 1 ·	4 ·
18	3 · 1 ○ 2 ·	4 ·
19 ○ 1 ·	3 · 2 · ○	4 ·
20	2 · 3 ○ 1 ·	4 ·
21	1 · ○ 4 2 · 3 ·	
22	4 · ○ 3 1 ·	3 ·
23	4 · 2 · 1 · ○ 3 ·	
24	4 · 2 3 ○ 1 ·	
25	4 · 3 · 1 · ○ 2 ·	
26 ○ 2 ·	4 · 3 · ○ 1 ·	
27	4 · 2 · 3 · ○	1 ●
28	4 · 1 · ○ 2 · 3 ·	
29	4 · ○ 1 2 · 3 ·	
30	2 · 1 · ○ 3 ·	4 ●
31 ○ 3 ·	2 · ○ 1. 4 ·	

Phenomena of Jupiter's Satellites.

VISIBLE AT WASHINGTON.

[From the *American Ephemeris.*]

CENTRAL STANDARD TIME.

1919	h	m		
Jan. 5	11	37	IV	Tr. I.
	12	34	IV	Sh. I.
	13	49	IV	Tr. E.
	14	49	IV	Sh. E.
6	6	00	I	Ec. R.
	10	06	III	Oc. D.
	13	49	III	Ec. R.
8	14	20	II	Tr. I.
	14	42	II	Sh. I.
	17	02	II	Tr. E.
	17	25	II	Sh. E.
9	16	29	I	Oc. D.
10	9	12	II	Oc. D.
	12	20	II	Ec. R.
	13	47	I	Tr. I.
	14	01	I	Sh. I.
	16	01	I	Tr. E.
	16	16	I	Sh. I.
11	10	55	I	Oc. D.
	13	26	I	Ec. R.
12	6	09	II	Tr. E.
	6	43	II	Sh. E.
	8	13	I	Tr. I.
	8	29	I	Sh. I.
	10	27	I	Tr. E.
	10	44	I	Sh. E.
13	5	21	I	Oc. D.
	7	55	I	Ec. R.
	13	21	III	Oc. D.
14	5	43	I	Tr. E.
	5	13	I	Sh. E.
15	16	35	II	Tr. I.
17	4	49	III	Sh. I.
	6	23	III	Tr. E.
	8	01	III	Sh. E.
	11	26	II	Oc. D.
	14	55	II	Ec. R.
	15	31	I	Tr. I.
	15	55	I	Sh. I.
18	12	39	I	Oc. D.
	15	22	I	Ec. R.
19	5	43	II	Tr. I.
	6	38	II	Sh. I.

1919	h	m		
Jan. 19	8	26	II	Tr. E.
	9	21	II	Sh. E.
	9	57	I	Tr. I.
	10	24	I	Sh. I.
	12	11	I	Tr. E.
	12	38	I	Sh. E.
20	7	06	I	Oc. D.
	9	50	I	Ec. R.
	16	39	III	Oc. D.
21	4	52	I	Sh. I.
	6	38	I	Tr. I.
	7	07	I	Sh. E.
22	6	32	IV	Sh. I.
	9	01	IV	Sh. E.
24	6	33	III	Tr. I.
	8	48	III	Sh. I.
	9	42	III	Tr. E.
	12	02	III	Sh. E.
	13	41	II	Oc. D.
25	14	25	I	Oc. D.
26	8	01	II	Tr. I.
	9	15	II	Sh. I.
	10	43	II	Tr. E.
	11	42	I	Tr. I.
	11	58	II	Sh. E.
	12	18	I	Sh. I.
	13	56	I	Tr. E.
	14	33	I	Sh. E.
27	8	51	I	Oc. D.
	11	46	I	Ec. D.
28	6	08	I	Tr. I.
	6	47	I	Sh. I.
	6	48	II	Ec. R.
	8	23	I	Tr. E.
	9	01	I	Sh. E.
29	6	14	I	Ec. R.
30	8	37	IV	Oc. D.
	10	50	IV	Oc. R.
	15	09	IV	Ec. D.
31	9	55	III	Tr. I.
	12	48	III	Sh. I.
	13	05	III	Tr. E.

Note:—I., denotes ingress; E., egress; D., disappearance; R., reappearance; Ec., eclipse; Oc., occultation; Tr., transit of the satellite; Sh., transit of the shadow.

Occultations Visible at Washington.

[From the *American Ephemeris.*]

Date 1919	Star's Name	Magnitude	IMMERSION. Washington M.T. h	m	Angle from N. °	EMERSION. Washington M.T. h	m	Angle from N. °	Duration h	m
Jan. 7	19 Piscium	5.4	6	33	88	7	38	214	1	05
10	27 Arietis	6.4	6	36	352	6	57	322	0	21
11	14 H^1 Tauri	6.5	11	00	32	11	42	319	0	43
11	22 H^1 Tauri	6.1	13	29	47	14	12	310	0	43
15	*f* Geminorum	5.3	9	48	138	10	56	253	1	08
19	p^3 Leonis	6.1	11	06	147	12	09	266	1	03

VARIABLE STARS.

Minima of Variable Stars of Short Period.

[Calculated by D. C. Kazarinoff at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time; to obtain Eastern Standard time subtract 5h; Central Standard 6h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1919 January							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8				26 10				
RT Sculptor.	31.5	−26 13	9.6—10.5	0 12.3	3 11;	11 4;	18 20;	26 12				
UU Androm.	38.5	+30 24	10.7—11.9	1 11.7	1 7;	8 18;	23 15;	31 1				
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8	3 15;	11 3;	18 14;	26 2				
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	4 16;	10 19;	23 1;	29 3				
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	2 19;	9 22;	24 5;	31 8				
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	5 6;	12 2;	18 23;	25 20				
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	2 22;	10 2;	24 11;	31 15				
TX Cassiop.	44.4	+62 22	9.4—10.1	2 22.2	8 11;	17 6;	26 1;	31 21				
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	8 13;	16 12;	24 11;	29 18				
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6		11 11						
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	1 12;	12 23;	18 16;	30 4				
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	1 3;	14 18;	21 13;	28 8				
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	6 9;	14 6;	22 4;	30 2				
RW Tauri	3 57.8	+27 51	7.1—<11	2 18.5	1 22;	10 6;	18 13;	26 20				
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	1 20;	9 17;	17 15;	25 12				
RW Persei	13.3	+42 04	8.8—11.0	13 04.8		12 13;	25 18					
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	7 23;	17 10;	26 21;	30 1				
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1		12 21;	25 7					
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	5 14;	12 6;	18 22;	25 14				
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	1 3;	9 8;	17 12;	25 17				
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	1 5;	13 6;	25 7;	31 8				
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	2 21;	9 9;	18 1;	26 17				
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	5 18;	10 23;	21 9;	31 19				
SV Gemin.	54.6	+24 28	9.8—<11	4 00.2	5 5;	13 6;	21 6;	29 6				
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	2 22;	14 9;	20 3;	31 14				
U Columbae	6 11.2	−33 03	9.2—10.0	2 19.2	3 5;	14 10;	20 0;	31 5				
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	5 16;	13 21;	22 2;	30 7				
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	6 12;	14 3;	21 18;	29 9				
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0	3 3;	15 8;	27 13					
RU Monoc.	6 49.4	− 7 28	9.8—10.5	0 21.5	1 0;	15 8;	22 12;	29 16				
R Can. Maj.	7 14.9	−16 12	5.8— 6.4	1 03.3	1 5;	14 20;	21 16;	28 11				
RY Gemin.	21.7	+15 52	8.9—<10	9 07.2		9 1;	18 8;	27 15				
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	6 11;	13 2;	19 16;	26 7				
TX Gemin.	30.3	+17 8	10.0—11.9	2 19.2	6 5;	14 15;	23 0;	31 10				
RR Puppis	43.5	−41 08	9.4—10.7	6 10.3	7 10;	13 20;	20 6;	26 17				
V Puppis	7 55.4	−48 58	4.1— 4.8	1 10.9	7 8;	14 14;	21 21;	29 4				
X Carinae	8 29.1	−58 53	7.9— 8.7	0 13.0	4 12;	12 15;	20 18;	28 21				
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	2 14;	12 1;	21 13;	31 0				
RX Hydrae	9 00.8	− 7 52	9.1—10.5	2 6.8	3 0;	16 17;	23 13;	30 9				
S Velorum	29.4	−44 46	7.8— 9.3	5 22.4	4 11;	16 7;	22 6;	28 4				
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	7 4;	13 22;	20 16;	27 10				
RR Velorum	10 17.8	−41 36	10.0—10.9	1 20.5	1 11;	16 7;	23 17;	31 3				
SS Carinae	10 54.2	−61 23	12.2—12.8	3 07.2	4 12;	11 2;	24 7;	30 22				
ST Urs. Maj.	11 22.4	+45 44	6.7— 7.2	8 19.2	1 5;	10 0;	18 19;	27 14				
RW Urs. Maj.	35.4	+52 34	10.3—11.4	7 07.9	3 16;	11 0;	18 7;	25 15				
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	6 10;	13 5;	20 0;	26 19				
RZ Centauri	12 55.6	−64 05	8.5— 8.9	1 21.0	5 19;	13 7;	20 19;	28 7				
RS Can. Ven.	13 06.3	+36 28	7.5—12.5	4 19.1	7 22;	17 12;	27 2;	31 21				
SS Centauri	13 07.2	−63 37	8.8—10.4	2 11.5	3 15;	11 1;	18 11;	25 22				
δ Librae	14 55.6	− 8 07	4.8— 6.2	2 07.9	6 15;	13 14;	20 14;	27 13				

Minima of Variable Stars of Short Period—Continued.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1919 January							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
U Coronae	15 14.1	+32 01	7.6— 8.7	3 10.9	1 20;	15 15;	22 13;	29 11				
TW Draconis	32.4	+64 14	7.3— 8.9	2 19.3	3 19;	12 5;	20 16;	29 2				
SS Librae	15 43.4	−15 14	9.3—11.5	0 18.4	7 13;	15 5;	22 21;	30 13				
SW Ophiuchi	16 11.1	− 6 44	9.2—10.0	2 10.7	5 15;	12 23;	20 7;	27 16				
SX Ophiuchi	12.6	− 6 25	10.5—11.2	2 01.5	1 14;	9 20;	18 2;	26 8				
R Arae	31.1	−56 48	6.8— 7.9	4 10.2	4 21;	13 17;	22 13;	31 10				
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1	3 9;	13 2;	24 3					
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	5 15;	12 10;	19 5;	26 0				
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	2 18;	11 4;	19 13;	27 22				
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	2 9;	14 16;	20 20;	26 23				
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	7 11;	14 16;	21 21;	29 2				
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	3 2;	10 11;	17 20;	25 5				
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	4 22;	13 3;	21 7;	29 11				
TX Scorpii	48.6	−34 13	7.5— 8.2	0 22.6	3 11;	11 0;	18 13;	26 2				
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	2 4;	9 22;	17 16;	25 10				
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	3 6;	11 6;	19 5;	27 5				
WX Sagittae	53.6	−17 24	9.2—10.8	2 03.1	7 10;	15 22;	24 11;	29 17				
WY Sagittae	17 54.9	−23 1	9.5—10.6	4 16.0	6 0;	15 8;	24 16;	29 8				
SX Draconis	18 03.0	+ 58 23	9.3—10.5	5 04.1	1 15;	12 0;	22 8;	27 12				
RS Sagittarii	11.0	−34 08	5.9— 6.3	2 10.0	4 10;	11 16;	18 22;	26 4				
V Serpentis	11.1	−15 34	9.5—11.1	3 10.9	6 13;	13 11;	20 8;	27 6				
RZ Scuti	21.1	− 9 15	7.4— 8.3	15 03.2		10 18;	25 21					
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	7 6;	14 10;	21 14;	28 18				
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	2 20;	9 23;	24 5;	31 7				
SX Sagittarii	39.7	−30 36	8.7— 9.8	2 01.8	2 0;	10 7;	18 15;	26 22				
RR Draconis	40.8	+62 34	9.3—13	2 19.9	2 6;	10 18;	19 5;	27 17				
RS Scuti	43.7	−10 21	9.3—10.3	0 15.9	2 13;	15 20;	22 11;	29 2				
β Lyrae	46.4	+33 15	3.4— 4.1	12 21.8	8 0		20 22					
U Scuti	18 48.9	−12 44	9.1— 9.6	0 22.9	6 22;	14 14;	22 5;	29 20				
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	7 12;	15 2;	22 16;	30 6				
RV Lyrae	12.5	+32 15	11. —12.8	3 14.4	4 16;	11 21;	18 1;	26 6				
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	8 9;	17 8;	26 7;	30 18				
U Sagittae	14.4	+19 26	6.5— 9.0	3 09.1	5 16;	12 10;	19 5;	25 23				
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	3 20;	11 5;	18 14;	25 22				
TT Lyrae	24.3	+41 30	9.4—11.6	5 05.8	2 16;	13 4;	23 15;	28 21				
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	4 6;	10 18;	23 19;	30 8				
SY Cygni	19 42.7	+32 28	10 —12	6 00.2	1 13;	13 13;	25 13;	31 14				
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	2 5;	15 11;	22 2;	28 18				
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	2 23;	12 3;	21 6;	30 10				
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	4 5;	12 16;	21 2;	29 12				
RW Capric.	12.2	−17 59	8.8—10.6	3 09.4	4 20;	11 15;	25 4;	31 23				
UW Cygni	19.6	+42 55	10.5—13	3 10.8	1 19;	15 14;	22 12;	29 9				
V Vulpec.	32.3	+26 15	8.2—9.8	37 19.0	7 13							
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	7 3;	16 18;	26 9;	31 4				
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	9 15;	18 20;	23 10;	28 0				
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	6 7;	13 19;	21 7;	28 19				
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	1 15;	9 6;	16 20;	24 10				
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	5 1;	15 4;	25 6;	30 7				
VV Cygni	21 02.3	+45 23	12.1—13.8	1 11.4	1 5;	16 0;	23 9;	30 18				
AE Cygni	09.0	+30 20	10.8—11.4	0 23.3	6 9;	16 2;	25 19;	28 18				
RY Aquarii	14.8	−11 14	8.8—10.4	1 23.2	8 4;	16 1;	23 22;	31 19				
RT Lacertae	21 57.4	+43 24	9.1—10.5	5 01.7	1 19;	11 22;	22 2;	27 4				
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3		14 6						
RW Lacertae	22 40.6	+49 08	10.2—11.2	5 04.4	6 8;	11 13;	21 21;	27 2				
TT Androm.	23 08.7	+45 36	11.3—12.6	2 18.4	1 10;	9 17;	18 0;	26 8				
Y Piscium	29.3	+ 7 22	9.0—12.0	3 18.3	7 20;	15 9;	22 22;	30 11				
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	9 2;	17 8;	25 14;	29 17				

Maxima of Variable Stars of Short Period.

[Calculated by members of the class in General Astronomy at Carleton College.]

Given to the nearest hour in Greenwich mean time. To obtain Eastern standard time subtract 5h; Central standard time 6h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1919. January							
	h m	° ′		d h	d	h	d	h	d	h	d	h
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7			12	3				
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 1.7	6	5;	14	8;	22	12;	30	15
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	8	16;	16	10;	24	3;	31	21
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2	2	7;	17	2			31	22
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	6	2;	14	1;	21	23;	29	22
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	2	0;	9	19;	17	14;	25	9
TU Persei	3 01.8	+52 49	11.4—12.2	0 14.6	6	21;	14	4;	21	10;	28	17
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0			10	0;	26	0		
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	4	23;	13	13;	22	3;	30	17
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1			11	18;	22	21		
RX Aurigae	4 54.5	+39 49	7.2— 8.1	11 15.0	7	5;			18	20;	30	11
SX Aurigae	5 04.6	+42 02	8.0— 8.7	1 12.8	6	20;	14	11;	22	3;	29	19
SY Aurigae	05.5	+42 41	8.4— 9.5	10 03.3			19	7;	20	10;	30	14
Y Aurigae	21.5	+42 21	8.6— 9.6	3 20.6	6	12;	14	6;	21	23;	29	16
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	3	18;	14	19;	25	21;	31	9
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	8	2;	15	16;	23	6;	30	19
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3					19	5		
RT Aurigae	23.0	+30 33	5.1— 6.0	3 17.5	1	7;	16	5;	23	16;	31	3
RZ Camelop.	23.7	+67 06	11.0—13.0	0 11.5	9	3;	16	8;	23	13;	30	18
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	7	1;	14	23;	22	21;	30	19
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	3	3;	13	6;	23	10		
RU Camelop.	7 10.9	+69 51	8.5— 9.8	22 06.5	3	16			25	22		
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	5	4;	13	3;	21	2;	29	0
V Carinae	8 26.7	−59 47	7.4— 8.1	6 16.7	3	22;	17	7;	24	0;	30	16
T Velorum	8 34.4	−47 01	7.6— 8.5	4 15.3	4	1;	13	7;	22	14;	31	21
V Velorum	9 19.2	−55 32	7.5— 8.2	4 08.9	3	15;	12	9;	21	3;	29	21
Z Leonis	9 46.4	+27 22	7.9— 9.6	59 0.00								
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	4	5;	17	19;	24	14;	31	9
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	3	9;	16	14;	23	5;	29	19
S Muscae	12 07.4	−69 36	6.4— 7.3	9 15.8	3	22;	13	14;	23	5		
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	3	14;	11	13;	19	13;	27	12
T Crucis	15.9	−61 44	6.8— 7.6	6 17.6	3	12;	16	23;	23	16;	30	10
R Crucis	18.1	−61 04	6.8— 7.9	5 19.8	5	19;	17	10;	23	6;	29	2
S Crucis	12 48.4	−57 53	6.5— 7.6	4 16.6	8	23;	13	16;	23	1;	27	17
W Virginis	13 20.9	− 2 52	8.7—10.4	17 06.5	6	13			23	20		
SS Hydrae	25.0	−23 08	7.4— 8.1	8 4.8	3	15;	11	20;	20	0;	28	5
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	2	15;	16	16;	23	16;	30	17
ST Virginis	14 22.5	− 0 27	10.3—11.4	0 09.9	2	10;	10	15;	18	20;	27	1
V Centauri	25.4	−56 27	6.4— 7.8	5 11.9	5	9;	16	8;	21	20;	27	8
RS Bootis	29.3	+32 11	8.9—10.0	0 09.1	4	6;	11	20;	19	9;	26	22
RU Bootis	14 41.5	+23 44	12.8—14.3	0 11.9	6	6;	13	16;	21	2;	28	12
R Triang. Austr.	15 10.8	−66 08	6.7— 7.4	3 09.3	3	23;	17	12;	24	7;	31	2
S Triang. Austr.	15 52.2	−63 29	6.4— 7.4	6 07.8	7	4;	13	12;	19	20;	26	3
S Normae	16 10.6	−57 39	6.6— 7.6	9 18.1	4	11;	14	6;	24	0		
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	1	16;	10	13;	19	10;	28	6
RV Scorpii	16 51.8	−33 27	6.7— 7.4	6 01.5	8	6;	14	8;	20	9;	26	11
X Sagittarii	17 41.3	−27 48	4.4— 5.0	7 00.3	2	15;	16	16;	23	16;	30	17
Y Ophiuchi	47.3	− 6 07	6.1— 6.5	17 02.9	3	19			20	22		
W Sagittarii	17 58.6	−29 35	4.3— 5.1	7 14.3	6	1;	13	16;	21	6;	28	20
Y Sagittarii	18 15.5	−18 54	5.4— 6.2	5 18.6	5	9;	16	22;	22	17;	28	11
U Sagittarii	26.0	−19 12	6.5— 7.3	6 17.9	4	2;	10	19;	24	7;	31	1
Y Scuti	32.6	− 8 27	8.7— 9.2	10 08.3	7	17;	18	2;	28	10		
Y Lyrae	18 34 2	+43 52	11.3—12.3	0 12.1	8	12;	14	13;	20	14;	26	14

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1919. January
	h m	° ′		d h	d h; d h; d h; d h; d h
RZ Lyrae	18 39.9	+32 42	9.9—11.2	0 12.3	6 18; 12 21; 25 4; 31 7
RT Scuti	44.1	−10 30	9.1— 9.7	0 11.9	4 20; 16 17; 22 16; 28 15
κ Pavonis	18 46.6	−67 22	3.8— 5.2	9 02.2	7 5; 16 8; 25 10
U Aquilae	19 24.0	− 7 15	6.2— 6.9	7 00.6	4 11; 11 11; 18 12; 25 12
XZ Cygni	30.4	+56 10	8.6— 9.3	0 11.2	4 23; 14 23; 21 23; 28 23
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	5 20; 13 19; 21 19; 29 18
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	4 6; 11 23; 19 16; 27 8
η Aquilae	47.4	+ 0 45	3.7— 4.5	7 04.2	8 17; 15 21; 23 2; 30 6
S Sagittae	51.5	+16 22	5.6— 6.4	8 09.2	7 9; 15 18; 24 3
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	4 5; 16 20; 23 4; 29 11
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3	12 19; 29 4
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	3 12; 12 9; 21 6; 30 2
WY Cygni	52.3	+30 03	9.6—10.4	0 13.5	3 19; 10 12; 23 23; 30 17
RV Capric.	55.9	−15 37	9.2—10.1	0 10.7	7 14; 14 7; 21 0; 27 17
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4	2 10; 17 1; 31 21
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	7 18; 15 14; 23 11; 31 7
SW Aquarii	10.2	− 0 20	9.9—10.8	0 11.0	7 21; 14 18; 21 15; 28 13
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	5 7; 15 0; 24 18; 29 15
Y Lacertae	22 05.2	+50 33	9.1— 9.6	4 07.8	8 3; 16 18; 25 10; 29 18
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	8 19; 14 3; 24 21; 30 6
Z Lacertae	36.9	+56 18	8.2— 9.0	10 21.1	8 22; 19 19; 30 16
RR Lacertae	37.5	+55 55	8.5— 9.2	6 10.1	5 11; 11 21; 24 17; 31 3
V Lacertae	44.5	+55 48	8.5— 9.5	4 23.6	5 2; 15 1; 25 20; 29 23
X Lacertae	22 45.0	+55 54	8.2— 8.6	5 10.7	2 0; 12 21; 23 19; 29 5
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	6 9; 17 6; 22 16; 28 3
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	8 1; 14 9; 20 16; 26 23
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4	9 22 22 2
V Cephei	23 51.7	+82 38	6.0—7.0	0 23.9	5 0; 12 0; 18 23; 25 23

NOTES FOR OBSERVERS.

Monthly Report of the American Association of Variable Star Observers, October-November, 1918.

Despite the distracting influences of the times, it is most gratifying to note the continuing interest taken in our work and the growth and prosperity of the Association. The Secretary holds eight applications for membership to be acted on at the coming meeting, which will place our membership well over the hundred mark.

The five-inch telescope lately purchased by the Association has been sent to Mr. Charles Y. McAteer, of Pittsburg, for his use, and no doubt in his experienced hands will be put to the best service. Mr. McAteer has been a consistent and faithful observer for many years and well deserves the honor of being the first to have the use of the Association glass. We hope to purchase other telescopes as time goes on, and these placed in the hands of worthy observers will greatly add to the service we are endeavoring to render Science.

At the coming meeting we expect to incorporate the Association under the Laws of the State of Massachusetts. Mr. Jordan is attending to the matter and this action will be of distinct advantage to the Association,

A number of observers who have had the irregular variable 054974 V Camelopard under observation for some time observed the increase in the brilliance of this star during the past month. Few maxima of this variable have been observed in recent years.

Variable Star Observations, Oct.-Nov., 1918.

Sept. 0 = 2421837

001726
T Androm.

J.D. 242	Est.	Obs.
1841.3	11.5	Pe
49.3	10.7	
62.3	10.1	
77.6	9.5	Wh
88.6	8.4	B
90.6	8.6	Pi
90.8	9.0	M

001755
T Cassiop.

1841.3	8.1	Pe
53.3	8.2	
75.5	7.7	B
89.6	7.9	Pi
89.8	8.8	M

001838
R Androm.

1840.3	6.7	Pe
51.3	6.9	
62.3	7.1	
67.3	7.2	
70.6	7.5	B
75.6	7.4	Wh
89.6	7.5	Hu
90.6	8.0	Pi
90.8	7.7	M

001909
S Ceti

1840.3	10.0	Pe
51.3	10.1	
63.3	11.6	
70.6	11.7	Y

003179
Y Cephei

1875.6	9.5	Hu
88.6	10.4	B

004047
U Cassiop.

1841.3	11.4	Pe
50.3	10.9	
63.3	10.0	
76.6	9.5	Y
88.6	8.8	B
89.6	9.0	Pi
90.8	8.8	M
91.6	8.8	Wh

004131
RW Androm.

1875.6	14.0	B
89.6	13.5	Me

004435
V Androm.

J.D. 242	Est.	Obs.
1868.6	9.0	B
77.6	9.5	Wh
89.6	9.7	B
89.6	10.0	Hu
90.8	9.8	M

004533
RR Androm.

1870.6	13.1	B

004746a
RV Cassiop.

1870.6	13.2	B
89.6	10.8	Pi

004958
W Cassiop.

1868.6	8.5	Hu
88.6	8.5	B
89.6	9.0	Pi
90.8	8.8	M
91.6	8.7	Wh

010102
Z Ceti

1870.6	9.0	Y

010940
U Androm.

1868.6	10.8	B
77.6	10.8	Wh
89.6	11.4	B
89.6	11.8	Hu
90.8	11.2	M

011041
UZ Androm.

1890.8	11.8	M

011272
S Cassiop.

1875.6	8.9	B
89.6	9.5	Pi
90.8	9.5	M
91.6	9.1	Wh
97.6	9.7	Pt

011712
U Piscium

1889.6	11.8	Me

012350
RZ Persei

1868.7	12.7	B
75.5	12.4	Y
89.5	13.5	B

012502
R Piscium

1870.6	9.0	Y
77.7	9.3	Wh

Oct. 0 = 2421867

013238
RU Androm.

J.D. 242	Est.	Obs.
1875.6	12.8	B

013338
Y Androm.

1875.6	10.5	B
89.6	9.7	Me

014958
X Cassiop.

1875.5	11.0	Y
75.8	11.8	M
88.6	10.5	B

015354
U Persei

1868.6	8.3	Hu
68.6	8.6	Y
68.7	8.6	B
70.6	8.6	Wh
89.5	9.4	Me
89.6	8.8	B

015912
S Arietis

1875.6	13.6	B
77.6	12.3	Wh

021024
R Arietis

1840.3	8.6	Pe
50.3	8.4	
63.3	8.9	
76.7	8.4	B
89.6	9.0	Me
95.6	9.2	Pt

021143
W Androm.

1870.6	12.0	Wh
75.6	12.1	B

021403
o Ceti

1840.4	3.9	Pe
51.4	3.7	
62.3	3.9	
67.3	3.9	
74.7	3.8	Pt
76.8	3.5	Mu
78.8	3.4	
95.6	4.1	Pt
95.7	3.6	Mu

021558
S Persei

1878.6	9.1	B

022000
R Ceti

1851.4	9.7	Pe
63.4	8.8	
70.6	8.5	Y

Nov. 0 = 2421898

022150
RR Persei

J.D. 242	Est.	Obs.
1875.5	13.0	Y
78.6	13.0	B

022813
U Ceti

1876.6	12.0	Y

023133
R Trianguli

1870.6	11.0	Wh
78.6	11.3	B

024356
W Persei

1853.3	10.7	Pe
68.7	10.7	B
70.6	11.5	Wh
78.7	10.7	B

032043
Y Persei

1878.6	8.8	B

032335
R Persei

1870.6	9.0	Wh
70.7	9.3	B

033362
U Camelop.

1870.6	7.0	Wh

042215
W Tauri

1879.8	12.4	M

043065
T Camelop.

1881.8	12.3	M

043274
X Camelop.

1874.7	13.4	B
76.6	12.8	Y

050953
R Aurigae

1871.8	9.5	M
78.7	9.3	B
93.8	9.3	M

052034
S Aurigae

1871.8	9.4	M
98.6	10.0	Wh

053005
T Orionis

1875.8	11.4	M

053068
S Camelop.

1868.6	10.0	Y

053531
U Aurigae

J.D. 242	Est.	Obs.
1893.8	11.3	M

054319
SU Tauri

1893.8	9.2	M

054974
V Camelop.

1874.6	10.6	Wh
74.7	9.6	B
76.6	9.5	Y
81.6	9.8	Wh
81.6	9.0	M
82.8	9.1	
85.8	9.4	
88.6	9.3	Wh
97.8	9.7	M
98.6	9.0	Wh

054920
U Orionis

1881.8	8.5	Pt
93.8	8.8	M

055353
Z Aurigae

1868.6	11.0	Y
81.8	11.2	M

060450
X Aurigae

1881.8	10.6	M
98.7	10.4	Wh

060547
SS Aurigae

1881.8	10.9	M
85.7	11.4	

061647
V Aurigae

1868.6	9.6	Y
81.8	9.0	M

061702
V Monoc.

1881.8	8.0	M

063159
U Lyncis

1893.8	12.0	M

064030
X Gemin.

1900.8	10.0	M

064707
W Monoc.

1900.8	10.6	M

065111
Y Monoc.

1900.8	12 3	M

VARIABLE STAR OBSERVATIONS, Oct.-Nov., 1918—Continued

065208
X Monoc.

J.D. 242	Est.	Obs.
1900.8	9.8	M

070122
W Gemin.

1879.9	8.0	M

070122
R Gemin.

1879.9	7.6	M

070109
V Can. Min.

1900.9	9.0	M

070310
R Can. Min.

1900.9	10.2	M

071713
V Gemin.

1900.9	10.2	M

072708
S Can. Min.

1879.8	7.7	M
81.8	7.5	Pt

072811
T Can. Min.

1879.9	12.4	M

073508
U Can. Min.

1879.9	12.5	M

073722
S Gemin.

1879.8	9.2	M

074323
T Gemin.

1879.9	10.6	M

074922
U Gemin.

1879.9	<12.4	M

081112
R Cancri

1881.8	11.3	M
1900.9	11.4	M

093178
Y Draconis

1868.5	13.0	Y

094211
R Leonis

1882.9	9.9	M

095421
V Leonis

1879.9	12.3	M
91.9	12.1	

103769
R Urs. Maj.

J.D. 242	Est.	Obs.
1839.3	10.4	Pe
43.3	10.7	
62.3	11.5	
79.9	12.3	M
88.5	12.3	B

111512
U Piscium

1874.6	12.5	Hu

122532
T Can. Ven.

1900.9	8.5	M

123160
T Urs. Maj.

1839.3	10.2	Pe
43.3	10.6	
50.3	11.3	
62.3	11.5	
74.6	12.2	B

123459
RS Urs. Maj.

1839.3	12.7	Pe
50.3	12.0	
62.3	9.8	
74.6	9.1	B
1900.9	9.1	M

123961
S Urs. Maj.

1820.4	8.6	L
39.3	9.9	Pe
43.3	10.1	
50.4	10.4	
62.3	10.5	
74.5	10.7	B

134440
R Can. Ven.

1868.5	8.0	Y
71.5	7.6	B
76.6	8.1	Pt

140113
Z Bootis

1874.5	12.5	Y

141567
U Urs. Min.

1863.6	12.2	Wh
71.5	8.1	B
81.6	8.8	Wh

141954
S Bootis

1888.6	8.8	Wh

142539
V Bootis

J.D. 242	Est.	Obs.
1839.3	10.4	Pe
70.6	7.5	Wh
94.5	8.0	We
95.6	7.9	Pt

142584
R Camelop.

1871.5	8.7	B
51.6	9.5	Wh

143227
R Bootis

1870.5	11.0	B
74.6	10.3	Wh

144918
U Bootis

1870.5	11.6	B
75.5	11.5	Y

151731
S Cor. Bor.

1840.3	12.0	Pe
68.5	12.0	Y
74.5	11.8	B

151714
S Serpentis

1870.6	10.0	Wh

153378
S Urs. Min.

1894.5	8.6	We
95.5	8.7	V

154428
R Cor. Bor.

1812.4	6.9	L
20.4	6.8	
24.3	6.7	
39.3	6.8	
43.3	6.8	
50.3	6.8	
62.3	6.7	
68.5	6.7	Y
69.6	6.7	Me
70.6	6.1	Pt
72.7	6.9	Mu
76.6	5.9	Pt
77.6	6.2	Wh
81.7	6.0	Pt
83.6	6.0	
88.6	6.0	
89.6	6.2	
95.5	6.8	V
95.6	6.1	Pt
97.6	5.9	

154536
X Cor. Bor.

1874.5	13.4	B

154615
R Serpentis

J.D. 242	Est.	Obs.
1870.5	13.2	B

155229
Z Cor. Bor.

1874.5	13.2	B

155947
X Herculis

1853.3	6.2	Pe
72.7	6.1	Mu
77.7	6.0	
96.6	6.0	

160118
R Herculis

1874.6	8.5	Hu
78.5	8.8	B

160210
U Serpentis

1870.6	8.5	Wh
89.5	9.2	Y

160625
RU Herculis

1870.6	13.7	B

161138
W Cor. Bor.

1889.5	12.5	Y

162119
U Herculis

1841.3	8.1	Pe
50.3	7.7	
62.3	7.6	
71.6	7.0	Hu
76.6	7.4	Pt
78.5	7.3	B
81.6	7.5	Wh
95.5	8.0	Pt

162542
g Herculis

1840.4	5.1	Hd
49.4	4.9	
51.4	5.1	
53.3	5.2	Pe
61.4	5.3	Hd
63.4	5.3	
67.4	5.2	
72.7	5.2	Mu
77.7	4.7	
96.6	4.7	

162807
SS Herculis

1871.6	12.2	B
74.6	12.5	Hu

163137
W Herculis

J.D. 242	Est.	Obs.
1871.6	11.4	B
74.6	10.9	Hu
99.5	12.2	Y

163172
R Urs. Min.

1871.6	9.5	B
81.6	9.7	Wh

163266
R Draconis

1874.6	11.0	B
95.6	10.0	Pi
96.6	9.6	Wh
99.5	10.2	Y

164055
S Draconis

1881.6	8.5	Wh
95.6	9.2	Pt
95.6	9.0	Pi

164715
S Herculis

1871.6	7.4	B
81.6	7.5	Wh
95.6	8.3	Pt

170215
R Ophiuchi

1839.3	8.8	Pe
76.6	8.0	Pt

170627
RT Herculis

1878.6	9.7	B

171401
Z Ophiuchi

1868.6	12.0	B

171723
RS Herculis

1841.3	8.2	Pe
50.3	8.2	
63.3	8.2	
68.6	8.2	Re
71.6	7.9	Hu
78.6	7.9	B
81.6	7.6	Wh
90.6	8.2	Re

172808
RU Ophiuchi

1874.6	12.7	B

173457
TY Draconis

1841.4	9.5	Pe
51.4	9.4	
53.4	9.3	
62.4	9.4	

VARIABLE STAR OBSERVATIONS, Oct.-Nov., 1918—Continued.

175111
RT Ophiuchi

J.D. 242	Est.	Obs.
1870.6	12.2	B

175458
T Draconis

J.D. 242	Est.	Obs.
1868.5	11.7	Y
71.6	11.1	B
99.5	11.4	Y

175458
UY Draconis

J.D. 242	Est.	Obs.
1868.5	11.6	Y
89.5	11.0	

175519
RY Herculis

J.D. 242	Est.	Obs.
1868.6	14.1	B
74.5	9.3	Y
90.5	13.9	B

180565
W Draconis

J.D. 242	Est.	Obs.
1874.5	9.8	Y
74.6	9.6	B
81.6	9.4	Wh
95.6	9.1	Pi

180531
T Herculis

J.D. 242	Est.	Obs.
1840.4	10.9	Pe
50.4	10.6	
62.4	8.9	
71.6	8.1	Hu
78.6	8.5	B
81.6	8.5	Wh
88.6	8.5	We
95.5	8.6	V
95.6	9.0	Pt

181031
TV Herculis

J.D. 242	Est.	Obs.
1840.4	10.3	Pe
50.4	10.2	
62.4	10.4	

181103
RY Ophiuchi

J.D. 242	Est.	Obs.
1868.6	8.3	Wh
90.5	8.4	B

181136
W Lyrae

J.D. 242	Est.	Obs.
1852.4	8.6	Pe
71.6	7.9	B
81.6	8.0	Wh
87.6	8.2	M
89.6	8.3	Pi
97.6	8.1	Pt
99.5	8.2	Y

182224
SV Herculis

J.D. 242	Est.	Obs.
1820.3	12.1	L
68.6	14.0	B

182306
T Serpentis

J.D. 242	Est.	Obs.
1874.5	12.8	Y

183308
X Ophiuchi

J.D. 242	Est.	Obs.
1820.4	6.3	L
90.5	8.4	B

184134
RY Lyrae

J.D. 242	Est.	Obs.
1875.6	10.1	Wh
91.6	10.7	

184243
RW Lyrae

J.D. 242	Est.	Obs.
1868.6	12.2	B
90.6	12.5	

184205
R Scuti

J.D. 242	Est.	Obs.
1812.4	6.3	L
20.3	5.9	
24.3	5.5	
38.4	6.0	Hd
40.3	5.6	Pe
40.3	6.0	Hd
49.3	5.3	
51.3	5.3	
53.3	5.5	
60.3	5.7	
61.3	6.0	Hd
63.3	5.7	Pe
66.6	5.7	My
67.3	6.0	Hd
69.5	5.8	Re
69.6	5.6	Pt
70.6	5.6	
70.6	6.0	My
72.7	5.5	Mu
74.6	5.3	Hu
74.6	6.0	My
74.7	5.7	Pe
75.6	5.5	Wh
75.6	5.6	Pt
76.6	5.6	
77.7	5.7	Mu
81.7	5.6	Pt
88.5	5.7	Re
88.6	5.4	Pt
88.6	5.8	We
89.6	5.5	Pt
93.7	5.8	Mu
94.6	5.2	Pi
95.6	5.6	Pt
96.6	5.6	Mu
97.6	5.5	Pt
98.6	5.5	

184300
Nova Aquilae

J.D. 242	Est.	Obs.
1812.3	4.4	L
16.3	4.4	
20.3	4.6	
24.3	4.2	
26.3	4.4	
27.3	4.6	
39.3	4.8	Pe

Nova Aquilae

J.D. 242	Est.	Obs.
1841.3	4.8	
42.6	4.8	V
45.6	4.9	
50.3	4.7	Pe
51.3	4.7	
53.3	4.7	
58.3	4.7	
62.3	4.9	
63.3	5.0	
66.3	5.1	My
67.3	4.8	Pe
68.5	4.9	Fa
68.6	5.1	My
68.6	5.0	Re
69.5	4.9	B
69.6	5.1	Me
69.6	5.0	Pt
70.5	5.0	J
70.5	5.0	B
70.6	4.9	Pt
70.6	4.9	Y
70.6	5.1	My
70.6	5.1	Fa
71.5	4.9	B
71.5	5.0	Fa
71.6	5.3	Wh
72.7	5.8	Mu
73.5	5.1	J
73.5	5.1	Re
74.5	5.1	J
74.5	5.0	B
74.6	5.1	My
74.7	5.1	Pt
75.5	5.0	B
75.6	5.1	Re
75.6	5.4	Wh
75.6	5.0	Pt
75.6	5.0	Y
75.6	5.1	J
76.6	5.1	Pt
77.6	5.0	B
77.6	5.4	Re
77.7	5.9	Mu
78.6	5.0	B
81.6	5.5	Wh
85.6	5.5	
86.6	5.3	My
87.6	5.1	Pt
88.5	5.2	Re
88.5	5.1	B
88.6	5.3	Pt
88.6	5.7	V
89.5	5.1	B
89.5	5.1	J
89.6	5.6	My
89.6	5.2	Pt
89.6	5.0	Pi
90.5	5.1	B
90.5	5.3	Re

Nova Aquilae

J.D. 242	Est.	Obs.
1891.6	5.1	Pi
93.5	5.8	V
93.7	5.5	Mu
94.6	5.0	Pi
95.6	5.8	V
95.6	5.5	Wh
95.6	5.4	Pt
96.6	5.7	Mu
97.5	5.6	V
97.6	5.2	Pt
98.5	5.1	J
98.6	5.3	Pt
99.6	5.4	Y

184408
S Scuti

J.D. 242	Est.	Obs.
1820.3	7.0	L
24.3	7.0	L

185045
R Lyrae

J.D. 242	Est.	Obs.
1850.4	4.6	Pe
72.7	4.5	Mu
77.7	4.5	
93.7	4.5	
96.7	4.4	

190108
R Aquilae

J.D. 242	Est.	Obs.
1870.6	9.8	B
74.6	10.8	Wh

190926
X Lyrae

J.D. 242	Est.	Obs.
1891.5	8.9	De

190967
U Draconis

J.D. 242	Est.	Obs.
1871.6	10.4	Hu

191033
RY Sagittarii

J.D. 242	Est.	Obs.
1820.4	6.7	L

191019
R Sagittarii

J.D. 242	Est.	Obs.
1839.3	8.4	Pe
40.3	8.5	
50.3	7.4	
74.6	6.6	B
95.6	7.0	Pt

191350
TZ Cygni

J.D. 242	Est.	Obs.
1868.5	11.4	Y
89.5	11.4	

191637
U Lyrae

J.D. 242	Est.	Obs.
1891.5	11.0	De

192928
TY Cygni

J.D. 242	Est.	Obs.
1874.5	13.0	Y

193449
R Cygni

J.D. 242	Est.	Obs.
1841.4	10.4	Pe
50.4	10.1	
52.4	10.0	
71.6	6.5	Wh
87.6	7.2	M
88.6	6.9	Pt
89.6	5.6	Hu
91.5	6.8	De
91.6	6.5	Pi
95.6	6.3	V

193509
RV Aquilae

J.D. 242	Est.	Obs.
1868.6	9.0	Hu
82.6	9.9	Wh

193732
TT Cygni

J.D. 242	Est.	Obs.
1889.6	7.1	Hu
89.6	8.1	Pt
91.5	8.2	De

194048
RT Cygni

J.D. 242	Est.	Obs.
1868.6	12.7	Hu
71.6	10.4	Wh
87.6	11.3	M
91.5	10.5	De
91.6	11.0	Pi
95.6	10.7	V

194348
TU Cygni

J.D. 242	Est.	Obs.
1868.6	12.2	Hu
91.5	11.8	De

194632
χ Cygni

J.D. 242	Est.	Obs.
1843.4	11.5	Pe
50.4	11.6	
76.6	12.4	B

195116
S Sagittae

J.D. 242	Est.	Obs.
1872.7	6.0	Mu
77.7	5.6	
93.7	5.3	
96.6	5.8	

195849
Z Cygni

J.D. 242	Est.	Obs.
1852.4	10.3	Pe
76.6	9.6	B
95.6	8.7	V
96.6	9.1	Wh

200212
SY Aquilae

J.D. 242	Est.	Obs.
1874.5	13.0	Y

VARIABLE STAR OBSERVATIONS, Oct.-Nov., 1918—Continued.

200357
S Cygni

J.D. 242	Est.	Obs.
1876.7	11.4	B
87.6	12.1	M

200647
SV Cygni

1881.7	9.0	M
89.6	7.8	Hu

200715a
S Aquilae

1874.6	11.0	Wh
77.7	9.9	Mu
88.6	10.2	B

200715b
RW Aquilae

1874.6	9.3	Wh
77.7	9.2	Mu
88.6	9.1	B

200812
RU Aquilae

1874.5	10.0	Y
74.6	9.6	Wh
74.6	9.5	B

200906
Z Aquilae

1876.6	10.2	B
88.6	10.3	Wh

200916
R Sagittae

1874.6	8.9	Wh
77.7	8.6	Mu
88.6	9.2	B

200938
RS Cygni

1871.8	8.4	M
95.6	8.5	Wh

201008
R Delphini

1868.6	10.2	B
74.6	10.4	Wh
89.6	11.4	B
98.6	11.7	Wh

201130
SX Cygni

1889.5	8.9	Y

201121
RT Capricorni

1812.4	8.1	L
75.6	7.1	Wh
88.6	8.0	We
95.6	8.0	Pt

201647
U Cygni

J.D. 242	Est.	Obs.
1852.4	8.0	Pe
81.7	8.0	M
95.6	8.5	Pt

202549
RW Cygni

1871.8	8.6	M
88.6	8.9	Me

202817
Z Delphini

1868.6	12.1	B
89.6	11.5	

202946
SZ Cygni

89.6	9.6	Hu
95.6	9.4	Pt

202954
ST Cygni

1876.7	12.2	B
89.6	12.8	Hu
90.6	13.0	Y

203226
V Vulpeculae

1874.6	8.5	Wh
95.6	9.0	Pt

203611
Y Delphini

1868.6	13.5	B

203816
S Delphini

1868.6	10.2	Hu
70.6	10.7	B
74.5	10.4	Y
74.6	10.4	Wh

203847
V Cygni

1876.7	12.5	B
89.5	12.9	Y

204215
U Capricorni

1890.6	11.8	Y

204318
V Delphini

1868.6	9.2	Hu
74.6	9.8	Y
74.6	9.0	Wh
88.6	9.9	B
98.6	9.9	Wh

200445
T Aquarii

1870.6	12.8	B

204846
RZ Cygni

J.D. 242	Est.	Obs.
1881.7	11.2	M

205017
X Delphini

1874.6	9.5	Wh
88.6	9.6	B
96.5	9.9	De

210116
RS Capricorni

1875.6	7.8	Wh

210129
TW Cygni

1878.6	14.0	B

210382
X Cephei

1875.6	11.0	Y
99.5	10.9	

210516
Z Capricorni

1868.6	9.8	Y

210868
T Cephei

1843.2	9.2	Pe
75.6	7.2	Hu
97.6	6.9	Pt

211614
X Pegasi

1890.6	12.0	Y

213244
W Cygni

1820.3	5.8	L
39.3	6.4	Pe

213678
S Cephei

1871.6	9.3	B
75.6	9.5	Hu
88.6	8.5	B

213753
RU Cygni

1891.6	9.4	Pi
93.8	9.0	M

213843
SS Cygni

1812.3	8.2	L
16.3	9.9	
20.3	10.5	
39.3	12.0	Pe
40.3	12.0	

SS Cygni

J.D. 242	Est.	Obs.
1868.5	11.8	Re
68.6	11.0	Hu
69.6	11.5	Me
70.5	11.7	B
74.6	11.9	Hu
74.7	11.7	B
75.5	11.9	Y
75.7	11.9	M
76.7	11.8	B
76.8	12.1	M
77.7	<10.9	Mu
81.7	11.8	M
88.6	11.5	B
88.6	12.0	Me
89.6	11.5	Y
89.6	11.6	Re
89.6	11.5	Pi
89.6	11.9	Hu
89.6	11.5	B
90.5	11.8	Y
90.6	11.5	B
90.6	11.5	Pi
91.6	11.5	
93.8	12.0	M
96.5	11.9	De
98.6	11.5	Re
98.7	11.7	Wh

213°37
RV Cygni

1871.7	7.9	M
88.6	8.2	Pt
89.6	7.5	Hu
91.6	8.1	Pi

215605
V Pegasi

1870.6	9.9	Wh
90.5	10.4	B
95.6	11.1	V

215934
RT Pegasi

1874.5	11.2	Y

220714
RS Pegasi

1871.6	12.2	B

222439
S Lacertae

1874.5	11.6	Y
88.5	11.8	B

225120
S Aquarii

1878.6	12.0	B
1890.5	11.8	Y

225914
RW Pegasi

J.D. 242	Est.	Obs.
1875.6	12.6	B
90.5	11.4	Y
97.6	11.1	V

230110
R Pegasi

1839.3	13.0	Pe
50.3	13.0	
90.5	12.8	Y

230759
V Cassiop.

1839.3	12.7	Pe
50.3	13.0	
68.5	11.2	B
91.6	9.9	Wh

231508
S Pegasi

1839.3	12.2	Pe
43.3	11.8	
50.3	12.1	
62.3	11.4	
70.6	11.4	Wh
75.6	11.4	B

233335
ST Androm.

1868.5	11.0	Re
71.6	11.2	B
75.6	11.3	Wh
89.6	10.8	Re
89 6	9.5	Hu
90.6	11.2	Pi

233815
R Aquarii

1851.3	9.3	Pi
63.3	8.4	
88.6	6.8	Wh
90.6	6.9	B
95.6	6.5	Pt

235350
R Cassiop.

1888.5	12.1	B

235525
Z Pegasi

1874.5	9.1	Y
77.6	8.6	Wh

235939
SV Androm.

1875.6	13.2	B

No. of Observations 747 No. of Stars Observed 196 No. of Observers 19

Messrs. Bouton and Meeker expect to spend the winter in Florida and will take their telescopes with them. Miss Reed is engaged in war work in Washington, D. C. Mr. Jordan is constructing a dome on his residence in Boston and hopes soon to become one of our active observers. Mr. Leslie Peltier of Delphos, O., is to be commended for the excellent progress he is making. Monsieur Houdard, who is at the Front, still finds time to observe and sent in this month a number of valuable observations of naked eye variables.

The following calculated dates of Maxima and Minima are cited from Mr. Leon Campbell's list:

Dec.	1	073508	U Can. Min.	Min.	Dec.	12	063558	S Lyncis	Min.
	2	162807	SS Herculis	Min.		18	043274	X Camelop.	Max.
	6	050953	R Aurigae	Max.		23	194048	RT Cygni	Max.
		180531	T Herculis	Min.		24	103769	R Urs Maj.	Min.
	10	153378	S Urs. Min.	Max.		31	201008	R Delphini	Min.
	11	163266	R Draconis	Max.			235350	R Cassiop.	Min.

Members will confer a favor if they will send in their lists so that they will be received by the secretary on the first day of the month.

The following members contributed to this report: Messrs. Bouton, Delmhorst, De Perrot, Francis, Houdard, Hunter, Jacobs, Lacchini, McAteer, Meeker, Mundt Murray, Peltier, Pickering, Reardon, Vrooman, Miss Weber, Whitehorn, Miss Young.

WILLIAM TYLER OLCOTT,
Secretary.

Norwich, Conn.
Nov. 10, 1918.

COMET AND ASTEROID NOTES.

Borrelly's Periodic Comet 1905 II.—Borrelly's periodic comet will be in good position for observation by the amateur astronomer during this month. It is a telescopic comet at best, but can be easily seen with a four or five inch telescope. The accompanying chart shows its course through the sky. On December 1 it will be in the constellation Gemini, just north of the center, almost midway between the stars α and ϵ. During the month it will move almost due north, a little more than a degree (or two diameters of the moon) a day. It will pass through the eastern margin of Auriga, through the northwestern part of Lynx and into the great constellation Camelopardus which has no bright stars in it.

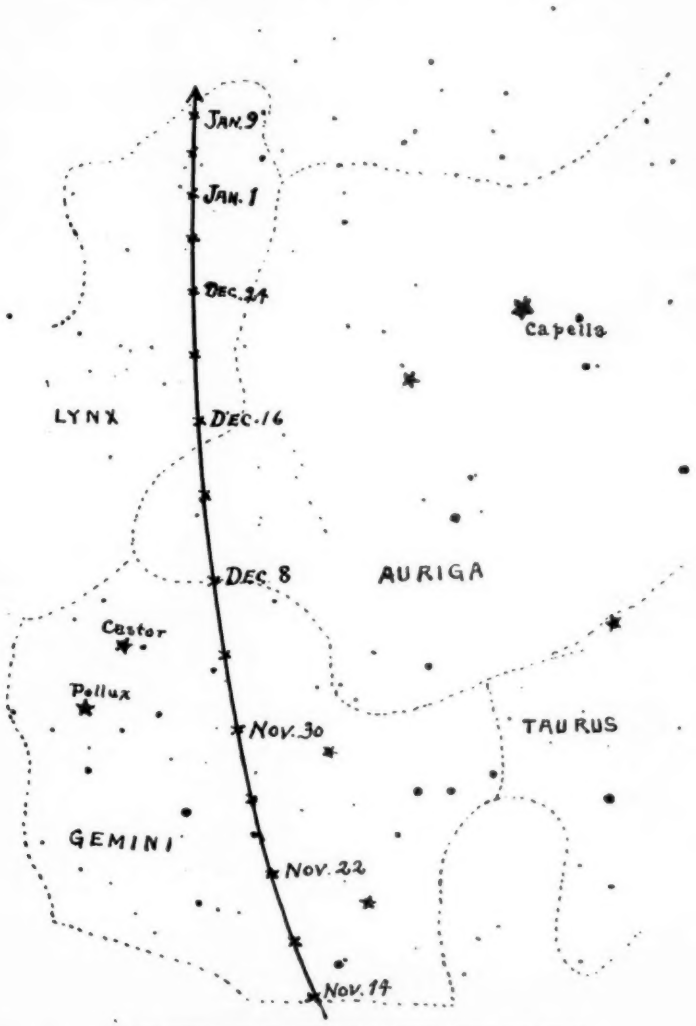
The comet was observed by Fayet at Nice on August 7, when the brightness factor $1{:}r^2\Delta^2$ was only 0.138. This factor will reach its maximum about December 4, when it will be 2.22, or 16 times as large as it was on August 7. After December 4 the brightness of the comet will diminish, so that at the end of the month it will be only ten times that of August 7. This statement is made on the assumption that the comet is shining by reflected sunlight only. If it should develop luminosity of its own, with irregular emissions of matter from the nucleus, it may be much brighter.

On November 22 the comet was barely visible in moonlight with the 5-inch finder of our telescope. In the 16-inch it was easily seen, being about 2′ in diameter, with a central nucleus of about magnitude 12.

The ephemeris which follows was computed by H. C. Wilson and D. C. Kazarinoff, from the elements of Fayet given on page 583 of the October 1918 number of POPULAR ASTRONOMY, except that the time of perihelion passage T was corrected to

T = 1918 Nov. 16.6009 G. M. T.

in accordance with circular No. 70 of the Marseilles Observatory.



APPARENT PATH OF BORRELLY'S COMET AMONG THE STARS.

EPHEMERIS OF BORRELLY'S COMET (1905 II).

Greenwich Midnight 1918	α App. h m s	δ App. ° ′ ″	log r	log Δ	$1:r^2\Delta^2$
Nov. 30	7 00 49.0	+27 02 29	0.14760	9.68221	2.19
Dec. 1	1 11.7	28 10 33			
2	1 31.1	29 19 03			
3	1 47.3	30 27 52			
4	2 00.2	31 36 52	0.14941	9.67758	2.22
5	2 09.6	32 45 57			
6	2 15.8	33 55 00			
7	2 18.5	35 03 52			
8	2 17.9	36 12 28	0.15164	9.67749	2.20
9	2 13.7	37 20 40			
10	2 06.2	38 28 20			
11	1 55.1	39 35 22			
12	1 40.6	40 41 37	0.15429	9.68198	2.13
13	1 22.7	41 47 01			
14	1 01.4	42 51 25			
15	0 36.7	43 54 45			
16	7 00 08.5	44 56 56	0.15733	9.69079	2.01
17	6 59 36.8	45 57 52			
18	59 01.9	46 57 30			
19	58 23.7	47 55 44			
20	57 42.1	48 52 31	0.16074	9.70346	1.87
21	56 57.4	49 47 47			
22	56 09.5	50 41 29			
23	55 28.6	51 33 34			
24	54 25.0	52 24 01	0.16450	9.71938	1.71
25	53 18.7	53 02 48			
26	52 30.1	53 59 53			
27	51 29.2	54 45 16			
28	50 26.4	55 28 56	0.16859	9.73787	1.54
29	49 21.8	56 10 54			
30	48 25.6	56 51 09			
31	47 08.3	57 29 42			
1919					
Jan. 1	46 00.0	58 06 33	0.17297	9.75828	1.37
2	44 51.1	58 41 43			
3	43 41.8	59 15 13			
4	42 32.5	59 47 06			
5	41 23.6	60 17 23	0.17762	9.78004	1.22
6	40 15.3	60 46 07			
7	39 08.1	61 13 19			
8	38 02.0	61 38 52			
9	6 36 57.3	+62 03 19	0.18252	9.80264	1.07

Osculating Elements and Ephemeris of the Planet of the Jovian Group (659) Nestor.—With Mr. R. Andersen's elements (*A. N.* 4923) and with the aid of a set of perturbations calculated by Mr. P. Pedersen, I have computed the following system of osculating elements and an ephemeris for 1919.

EPOCH AND OSCULATION 1918 MARCH 11.0 G. M. T.

$$\left.\begin{aligned} M &= 179^\circ\ 57'\ 36''.2 \\ \omega &= 331\ \ 58\ \ 33\ .1 \\ \Omega &= 350\ \ \ 5\ \ 22\ .2 \\ i &= \ \ 4\ \ 31\ \ 45\ .3 \\ \phi &= \ \ 6\ \ \ 1\ \ 59\ .3 \end{aligned}\right\} 1919.0$$

$$\mu = 299''.803$$

$$\log a = 0.715447$$

EPHEMERIS.

12^h G. M. T.

1919	True α	True δ	log Δ
	h m s	° ′	
Feb. 20	11 19 2	+4 51.8	0.6750
24	17 14	5 1.6	
28	15 21	11.9	0.6720
Mar. 4	13 27	22.3	
8	11 31	32.8	0.6707
12	9 34	43.3	
16	7 40	5 53.6	0.6714
20	5 47	6 3.5	
24	3 58	13.1	0.6738
28	2 15	22.1	
Apr. 1	11 0 36	30.5	0.6779
5	10 59 5	38.2	
9	57 42	45.1	0.6836
13	56 27	51.1	
17	55 20	6 56.2	0.6905
21	54 23	7 0.4	
25	53 37	3.5	0.6985
29	53 1	5.6	
May 3	10 52 36	+7 6.7	0.7073

Opposition 1919 March 8.0 Mag. 14.8

Copenhagen, University Observatory
1918 October 10. JULIE MARIE VINTER HANSEN.

Ephemeris of Juno (3).—The enclosed ephemeris of the asteroid Juno (3) was computed for an astronomer who has been observing it more or less for quite a while, and claims that it varies somewhat, much the same as Eros, Eunomia and several other asteroids. I hope this may interest the readers of POPULAR ASTRONOMY.

EPHEMERIS OF ASTEROID JUNO (3) FOR DECEMBER 1918.

Greenwich Midnight 1918	α	δ	log r	log Δ
	h m s	° ′ ″		
Dec. 1	8 32 22	+ 1 16 51	0.32908	0.17350
5	8 33 3	+ 0 59 34	0.33082	0.16461
9	8 33 14	+ 0 45 22	0.33256	0.15596
13	8 32 59	+ 0 34 34	0.33422	0.14765
17	8 32 3	+ 0 28 12	0.33618	0.14014
21	8 30 44	+ 0 25 29	0.33796	0.13298
25	8 28 55	+ 0 27 24	0.33984	0.12672
29	8 26 39	+ 0 33 48	0.34170	0.12124

F. E. SEAGRAVE.

GENERAL NOTES.

Rotation of Celestial Bodies.—Messrs. Shinzo Shinjo and Yoshikatsu Watanabe, of the Kyoto Imperial University, have published the results of a study of the masses and angular momenta of 76 visual systems and 10 spectroscopic binary stars. They find that these data are, broadly speaking, of about the same order of magnitude.

Assuming this to be generally true, they have calculated the probable amount of angular momentum of a primordial swarm of meteorites, having spherical symmetry and isolated from all external influences. They find that the angular momentum of such a swarm is not generally zero, so that the origin of celestial rotation may thus be accounted for. Upon this may be based a whole theory of the genesis of solar and planetary systems, excluding the gaseous nebulae.

Hindu Achievements in Exact Science.—A study in the History of Scientific Development, by Benoy Kumar Sarkar. Longmans, Green and Co., New York. pp. 82. Price $1.00, net.

This little book, which may be read through in three or four hours, gives in succinct form what is known about the scientific investigations of the Hindus in ancient and medieval times, as compared with those of the Greeks, Chinese, and Saracens. In regard to Astronomy we notice the following statements:

"The cultivation of astronomy as science, after it began as such, did not make less progress among the Hindus than among the Greeks under Hipparchus and Ptolemy."

"The earliest astronomy of the Hindus is believed to have been borrowed from the Babylonians.....but may have been original to the Hindu priests.....The Saracens, however, learned their *manzil* (twenty-eight constellations) from the Hindus in the eighth century."

"Aryabhata (A. D. 476) knew the truth that the earth revolves on its axis. The true cause of solar and lunar eclipses also was explained by him."

Photographic Stellar Parallaxes.—In the *Contributions* from the Mount Wilson Solar Observatory No. 136 Dr. A. van Maanen gives the results of determinations of the relative parallaxes of 35 stars and one planetary nebula, from photographs taken at the 80-foot focus of the 60-inch reflector. In the scale of these photographs 1mm = 8″.227, so that the probable error of measurement of the photographs is extremely small, ranging from 0″.003 to 0″.011, the mean being ±0″.007. Thirty-three of the stars are between magnitudes 5.49 and 7.15 and are of spectral types F, G, K, and M. The parallaxes range from −0″.002 to +0″.058, except in the case of the double star 61 Cygni, where the components have the parallaxes 0″.325 and 0″.320, the brighter star being the nearer, if the difference of 0″.005 has any significance.

The two Orion-type stars B. D. +35° 4001 and 4013, of magnitudes 8.5 and 8.0, yield parallaxes +0″.011 and +0″.002 respectively.

The parallax found for the planetary nebula N. G. C. 7662 is +0″.021, with a probable error of ±0″.004, which would place the nebula at a distance of 155 light years.

Rotation and Radial Velocity of the Andromeda Nebula.—In the *Communications* from the Mount Wilson Solar Observatory to the National Academy of Sciences, No. 51, Mr. F. G. Pease gives the results of measurement of a spectrogram of the central part of the Andromeda nebula, taken with the focal plane spectrograph of the 60-inch reflector with an exposure of seventy-nine hours, during August, September and October, 1917. The slit was placed parallel to the major axis of the nebula and extended between 2′ and 3′ each way from the nucleus. The velocity curve is approximately a straight line, showing greater velocity of approach in the part south preceding the nucleus and less velocity in the north following part. Whether the motion is inward or outward along the spiral arms which join the central part depends on the inclination of the plane of the spirals to the line of sight. The inclination is either 14° or 166°, approximately. If the more prominent dark lanes in the nebula are on the nearer side of the central condensation (as seems probable, since the greater thickness of the central parts may obscure the lanes on the farther side) then the observed motion is inward.

At a distance of 2′ from the nucleus the linear velocity of rotation amounts to 58 km per second. The radial velocity of the nucleus comes out −316 km, agreeing well with former determinations.

From a spectrogram of eighty-four hours exposure made at intervals in August, September, and October, 1916, with the slit placed on the minor axis of the nebula, Mr. Adams obtained a velocity of −297 km, with practically no change depending on distance from the nucleus, which is quite consistent with the above.

Early Observations of Nova Aquilae on June 8.—A letter is published in the *Journal of the British Astronomical Association* for June, written on June 9 by Mr. G. Noel Bower of Nungambankam, Madras, describing his observation of Nova Aquilae on the evening of June 8. He says:

"About 9:30 last evening I was studying the constellations of the S. E. sky and working my way round from Scorpio to Cygnus with a view to studying Albireo, I noticed a brilliant star below Altair which I could not place. On consulting my atlases, I concluded that it must be a new star—Nova Aquilae, 1918!—and an exceptionally fine one at that, for it was brighter than the average first magnitude and compared favorably with Altair itself.

"I had not noted this star on Friday, the 7th. I was naturally quite excited, and explained what I knew of new stars to my companion with whom I was working, and recalled the discovery in February 1901 of Nova Persei, which I believe was recorded by Dr. Anderson, but was simultaneously pointed out to me in the middle of the triangle of Perseus by my father, J. G. Bower, at Norwich.

"Now if I recollect aright, Nova Persei of 1901 was about a 2½ magnitude star when first noticed, but afterwards became brighter than Capella itself, whereas the star I saw last night was brighter than the first magnitude.

"Doubtless this star has been reported by observers at home, but this bungalow is in longitude 80½° east and therefore gave me an opportunity of seeing it before it became visible in England.

"As I did not notice it on Friday, I should be much obliged if you will advise me when this nova was first reported."

As Mr. Bower probably used Indian Standard Time, this would mean that he saw the star at about 4^h G. M. T. This is fully four hours earlier than the observation by the keen-eyed Dutch amateur, Mr. Meesters, reported by Professor Nijland in *A. N.* 4950, at $8^h\ 8^m$, and by the well known and skillful observer, M. Luizet at Lyon ($8^h\ 40^m$ G. M. T.), each of whom discovered the star at the beginning of twilight. Accordingly so far as yet reported, Mr. Bower's is the earliest scientific observation of the nova after it reached the first magnitude. The invaluable photographs obtained at the Harvard Observatory 9^h earlier established beyond all peradventure that the star was of magnitude 6.2 at $5^h\ 10^m$ before Greenwich mean noon of the same day. This picture was reproduced as Plate XXIII in POPULAR ASTRONOMY for October, and appears in *Harvard Circular* No. 210. We learn also from that circular that two other photographs taken half an hour earlier yield a magnitude of 6.7. If this rapid rate of increase of one magnitude per hour was maintained, then the star should have arrived at the first magnitude at about Greenwich mean noon of June 8.

If this was actually the case, the star should have been a notable object in the early evening of June 8 to the inhabitants of Japan, of the Philippines, of a large part of Australia and of great regions of Asia and Australasia. Doubtless it was seen by thousands of persons without being recognized; it is quite probable that it was distinguished as new or strange by sharp-eyed herdsmen familiar with the sky, perhaps by the Buddhist monks of Asia; but their observations are not likely to reach our civilization. It is possible that other scientific reports will yet arrive from which we may fix still more closely the time when the star reached the first magnitude. We already have the valuable information that the star's brightness increased a hundredfold within a period of nine hours, and perhaps in an even shorter time!*

* We are of course obliged to doubt the correctness of various announcements that the star was bright prior to June 8.

The September number of *The Observatory*, received since the above was written, contains a letter from Professor J. M. Baldwin, of Melbourne, who gives a report by Mrs. Thomas of Corowa, New South Wales. She states that she saw the star on Saturday evening, June 8, "between 10 and 11 o'clock or perhaps earlier", but could no identify it on her chart. She says, "As far as I can remember, it was as bright as Canopus or Alpha Centauri." Ten o'clock at her station would be Greenwich mean noon. This would indicate that the rise from sixth to first magnitude occupied less than six hours! E. B. F.

What Might have Happened!—In view of the early observations of Nova Aquila on June 8, reported above, let us consider what might have happened. The American solar eclipse of June 8 was total at 10^h G. M. T., or more than six hours after the observation of the nova by Mr. Bower. If the nova had been above the horizon it would therefore have been, during totality, a noticeable object to a person familiar with the sky. Suppose that the position of the nova had been in Taurus, say within 20° of the sun, instead of in the constellation Aquila. It would doubtless have been observed by not a few persons at eclipse stations. They would not, however, have had at hand the means of accurately fixing the position of the star. Would not our credulity have been taxed by the report that a strange star had been seen at a point where no bright star or planet was known to be, even if the observation were more or less definitely confirmed by astronomers at other stations? If the object had been recorded on a photographic plate, the evidence would have been doubted by the photographer himself unless corroborated on negatives taken with other instruments or at other points. In any case it would have been regarded as an extraordinary coincidence! And only the fact that the constellation of Aquila had not risen prevented this coincidence from actually happening.

There are two or three inferences which may be drawn from this remarkable circumstance.

1. We should always keep our minds open to the possibility that the unexpected may happen and we should be prepared to observe and record whatever is seen, however unexpected.

2. May it not be possible that temporary stars have been seen in the neighborhood of the sun during a total eclipse in the past?

3. If a nova had appeared in the vicinity of the sun, might it not easily happen that it would never have been observed again? The southern parts of the zodiac cannot be well photographed for about six months of the year, at northern observatories. Therefore if a nova appeared in that region and did not rise to great brightness, it might easily escape any photographic record, unless it happened to be photographed at an eclipse.

4. Hence observers at eclipses should make it a part of their regular plans to to photograph the sky during totality, particularly in the region of the sun, with a view to detecting such objects. Of course the chance of finding a comet near the sun is greater than that of picking up a nova; such observations of a comet (as at the eclipse of 1882) may be specially valuable, and would justify the use of a camera or cameras for the purpose. This possibility has heretofore been covered in many eclipses by the photographic search for an intramercurial planet, but on account of the negative evidence thus far obtained, there has been a tendency to omit such photographs from eclipse plans.

Although our view of the eclipse, surprisingly impressive in spite of the passing clouds, did not have this dramatic feature imagined above, nevertheless the later evening brought its thrill; and the spectacle of Nova Aquilae in the clear sky above the Wyoming desert, seen from the elevation of 6000 feet, will never be forgotten by by the members of our party,—particularly when the star was at its greatest brilliance on Sunday evening, June 9. EDWIN B. FROST.